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Chemical Analysis Reference
Volume

Science Applications, Inc., La Jolla, CA

Prepared for

Environmental Research Lab., Gulf Breeze, FL

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DRILLING MUD ASSESSMENT

CHEMICAL ANALYSIS REFERENCE VOLUME

by

Science Applications, Inc.

Environmental Chemistry Division

La Jolla, CA 92038

RIN-5760-83-N

Project Officer

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FOREWORD

The protection of our estuarine and coastal areas from damage caused by pollutants requires that regulations restricting the introduction of these compounds into the marine environment be formulated on a sound scientific basis. Accurate information describing concentration-response relationships for organisms and ecosystems under varying conditions is required. The Environmental Research Laboratory, Gulf Breeze, contributes to satisfying this information requirement through research programs aimed at determining:

> the effects of pollutants on individual species and communities of organisms.
>
> the effects on ecosystems processes and components.
>
> the significance of chemical carcinogens in estuarine and marine environments.

This report presents a chemical characterization of 11 industry-supplied drilling fluids collected from operating rigs in the Gulf of Mexico and one commercial drilling fluid additive. Concentrations of aromatics, aliphatics, selected heavy metals in the liquid, suspended particulate and whole mud phases of the drilling fluids are reported. These data will add to our knowledge of the chemical composition of drilling fluids and can be used by regulators and others as part of a risk assessment process.

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ABSTRACT

This report presents concentrations of specific metals and hydrocarbons in eleven drilling fluids (muds) taken from operating gas and oil rigs in the Gulf of Mexico. Each drilling fluid was analyzed chemically for heavy metal and hydrocarbon content in three distinct phases: (1) the bulk or whole mud, (2) a suspended phase derived from the bulk mud sample, and (3) a "dissolved" or liquid phase. Aliquots of bulk muds were removed for barium analyses by instrumental neutron activation and for analysis for iron, aluminum, lead, zinc, cadmium, copper, strontium, and calcium by atomic absorption analysis. Analysis of the suspended particulate and liquid phases was similar. The aromatic and aliphatic content of the three phases were determined by extraction and then fractionation by column chromatography.

The analysis for each of the 11 drilling fluids is presented in four parts:

A. Drilling fluid concentrations,
B. Whole drilling fluid organic concentrations,
C. Particulate phase organic concentrations,
D. "Dissolved" phase organic concentrations.

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I. INTRODUCTION

This compendium serves to document chemical characterization data obtained on eleven industry-supplied drill fluid mixtures (Table 1) and one commercial drill mud additive (Milgel®). Drill mud materials were obtained from PESA (Petroleum Equipment Suppliers Association) by the U.S. Environmental Protection Agency (Gulf Breeze Laboratory), and analyzed as part of a multidisciplinary assessment and cataloguing of acute aquatic toxicity and chemical make-up. Companion reports contain toxicity and bioaccumulation data.

All the materials analyzed are used in off-shore well drilling and, as a result, are candidates for ocean discharge as a means of waste disposal. Drill muds in general are mineral-based, typically enriched in barium (in the form of barite, $BaSO_4$), chromium and zinc, to name a few elements, and are fortified with a variety of other, usually synthetic, materials to obtain desired consistencies for drill-line lubrication and well-hole pressure control. The mineral base is typically a mixture of barite (barium sulfate) and various clays, and other additives are predominantly organic-based, but can contain relatively high concentrations of heavy metals. Presumably, drill muds which will eventually be disposed of at sea as a direct discharge are to be free of any potentially harmful additives, such as petroleum-derived compounds and other suspected toxicants.

TABLE 1. List of Samples Characterized for Chemical Content

Sample	Laboratory Identifier
MIBLKA51 Al-7	83-323
An 31-1-6	83-324
Milgel®	83-325
SV 76-2-5	83-326
P1-1-3	83-2000
P2-1-3	83-2001
P3-1-3	83-2002
P4-1-3	83-2003
P5-1-3	83-2004
P6-1-2	83-3312
P7-1-2	83-3313
P8-1-1	83-8537

As direct discharges, these materials are controlled under federal and state discharge permit requirements, which stipulate routine acute toxicity testing. Historically, a problem has existed in equating observed toxicities with chemical composition, largely because comparative sets of data have not existed.

In preparing this data reference report, the selected drill fluid materials were analyzed in the bulk ("whole mud") state, and as both dissolved and particulate bioassay phases. The two "bioassay" phases were prepared in a manner identical to the dissolved and particulate phases stipulated in EPA-prescribed acute toxicity protocols(1). Included in this reference volume are analytical procedure descriptions, followed by data on chemical concentrations and identifications.

It is readily apparent from the organic analysis results that a number of samples contain substantial amounts of petroleum-derived hydrocarbons. Although it is not possible to identify the source(s) of hydrocarbons found in the fluids analyzed, the qualitative evidence does not point toward crude oil contamination picked up from the drilled formations. Instead, in the cases of noticeable hydrocarbon presence, these components appear to be "refined" petroleum fractions.

II. METHODOLOGIES

A. Sample Preparation

Each drill fluid material was chemically analyzed for heavy metal and hydrocarbon contents in three distinct phases: 1) the bulk mud as supplied by PESA and shipped to the laboratory; 2) a suspended particulate phase derived from the bulk mud using the EPA Reigon II bioassay test procedures(1); and 3) a dissolved phase generated from the same protocols. One purpose of this approach was to examine the whole fluid mixture after it had been used, or "spent", in a drilling operation; this form represents the potential bulk waste discharge, data which are important in dispersion modeling and other impact assessment tools which can predict chemical influence. The second purpose was to create the same phases used in aquatic bioassay testing in order that correlations can be made between chemical content and degree of toxicity.

Whole Drill Fluid

Whole drill fluid samples were received frozen and, after thawing, were thoroughly homogenized. An approximate 30-g wet aliquot was removed from each bulk sample, weighed wet to the nearest mg, lyophilized (freeze-dried), and re-weighed to the nearest mg. This allowed determination of water content and also prepared a sample aliquot for heavy metal analysis (all metals except mercury). A separate wet aliquot was removed for hydrocarbon measurement.

Particulate Bioassay Phase

After measuring the pH of each drilling fluid sample (Table 2), 400-ml aliquots were added to 2000-ml graduated cylinders containing 200 ml of filtered seawater (pH 7.7). The volume was adjusted to 2000 ml with filtered seawater, the pH re-measured, and adjustments made with reagent grade 1N HNO_3 or 5% NH_4OH to original pH levels.

At this point, each sample was stirred vigorously in its cylinder for 30 minutes with a glass rod. After being allowed to settle for 1 hour, 1000 ml were syphoned from the tops using Teflon tubing. Of this "syphonate", a 50-ml aliquot was taken and stored in an acid-cleaned linear polyethylene bottle for subsequent heavy metal analyses, while the balance was placed into a continuous liquid/liquid extraction vessel for hydrocarbon analysis preparation.

Dissolved Bioassay Phase

Duplicate samples of each bulk drill fluid were made up in 2000-ml graduated cylinders with seawater as described above.

TABLE 2. Whole Drill Fluid pH Values

Sample No.	Lab I.D. No.	pH
MIBLKA51 A1-7	83-323	8.8
An 31-1-6	83-324	9.3
Milgel®	83-325	7.5
SV 76-2-5	83-326	9.3
P1-1-3	83-2000	9.4
P2-1-3	83-2001	9.8
P3-1-3	83-2002	9.3
P4-1-3	83-2003	7.4
P5-1-3	83-2004	8.9
P6-1-2	83-3312	7.9
P7-1-2	83-3313	9.2
P8-1-1	83-8537	9.1
	Method Blank	7.7

After 30 minutes of vigorous stirring, each sample was allowed to settle for 72 hours, after which the top, relatively clear layer was syphoned off with Teflon tubing. This upper layer of "clear" seawater varied in thickness depending on the settling characteristics of each drill fluid. Table 3 indicates the thickness of the syphoned layer for each sample. Each "syphonate" was centrifuged at 300 rpm for 10 minutes and decanted; each centrifugate was then filtered sequentially through 8.0 m, 0.8 m and 0.4 m membrane filters. Of the final filtrate volume for each sample, 50 ml were set aside in acid-cleaned linear polyethylene bottles for heavy metals analyses and the balance went to liquid/liquid extraction vessels.

B. Elemental Analysis Procedures

Whole Drill Fluid

After freeze-drying and powdering, an accurately weighed (to the nearest 0.1 mg) aliquot of ~0.25 g was removed for barium analysis by instrumental neutron activation, and an approximate 0.1-g aliquot (also to the nearest 0.1 mg) was removed for acid-digestion and atomic absorption analysis for iron, aluminum, chromium, lead, zinc, cadmium, copper, strontium and calcium.

For barium analyses, instrumental neutron activation included six-hour irradiation in a TRIGA reactor at 10^{12}

TABLE 3. Dissolved Bioassay Phase Syphon Volumes

Sample No.	Lab I.D. No.	Volume Syphoned (ml)
MIBLKA51 A1-7	83-323	1000 ml
An 31-1-6	83-324	840 ml
Milgel®	83-325	1000 ml
SV 76-2-5	83-326	940 ml
P1-1-3	83-2000	740 ml
P2-1-3	83-2001	600 ml
P3-1-3	83-2002	600 ml
P4-1-3	83-2003	1000 ml
P5-1-3	83-2004	1200 ml
P6-1-2	83-3312	1200 ml
P7-1-2	83-3313	340 ml
P8-1-1	83-8537	700 ml

neutrons/cm^2-sec, followed by a 12-day "cooling" period to allow interfering isotopes to decay, and a 30-minute to two-hour count of the Ba-131 line. Gamma counting was performed with a two-inch NaI Ge(Li) detector and a multi-channel analyzer. Detection limit of this procedure was 1-5 μg/g (dry sample weight).

In the case of the other metals, each accurately weighed aliquot (~0.1 g to the nearest 0.1 mg) was totally dissolved in a pressurized Teflon bomb, using a low-volume combination of nitric, hydroflouric and hydrochloric acids. The digestion was carried out in a 60°C water bath for approximately six hours, rendering each sample totally dissolved with the exception of observable, small amounts of barite (barium sulfate); this barite residue was considered to have no effect on the successful analysis of the other metals.

The resulting digestate was brought to volume with 1N nitric acid and analyzed by a combination of flame and flameless atomic absorption for the nine other elements. Tables 4 and 5 present the instrumental operating conditions for each element; in general, these follow the criteria given in EPA's Methods for Water and Wastewater(2) and in Standard Methods(3), with modifications to accommodate the complex drilling mud sample matrix.

TABLE 4. Instrument Operating Conditions and Detection Limits for Metals Analyzed by Graphite Furnace Atomic Absorption Spectrophotometry

Element	Wavelength (nm)	Lamp Current (mA)	Slit Width (nm)	Injection Volume (µl)	Gas	Furnace Conditions	Minimum Detection Limit (ppb)	Absolute Detection Limit (picograms)	Sensitivity (ppb/0.0044 Abs)	Sensitivity (picograms/0.0044 Abs)	Additional Comments
Al	309.3	20	0.7	20	Ar (3 sec, normal flow, 50)	Dry: 110°, 22 sec. Char: 1300°C, 22 sec. Atomize: 2700°C, 7 sec.	2	3	40	60	D_2 correction
Ba	55	25	0.2	50	N_2 (3 sec, normal flow, 85)	Dry: 110°C, 30 sec. Char: 1800°C, 30 sec. Atomize: 2800°C, 8 sec.	10	500	20	1000	No D_2 correction
Ca	422	10	0.7	20	Ar (3 sec, normal flow, 20)	Dry: 110°C, 22 sec. Char: 1100°C, 22 sec. Atomize: 2700°C, 7 sec.	0.5	10	1	20	No D_2 correction Environmental Contamination
Cd	228.8	4	0.7	10	Ar (3 sec, normal flow, 20)	Dry: 110°C, 22 sec. Char: 350°C, 22 sec. Atomize: 2100°C, 7 sec.	0.1	1	0.3	3	D_2 correction
Cr	357.9	8	0.7	20	Ar (3 sec, normal flow, 30)	Dry: 110°C, 22 sec. Char: 1100°C, 22 sec. Atomize: 2700°C, 7 sec.	0.5	10	0.7	14	D_2 correction
Cu	324.7	10	0.7	20	Ar (3 sec, normal flow, 40)	Dry: 110°C, 22 sec. Char: 900°C, 22 sec. Atomize: 2700°C, 7 sec.	0.5	10	1	20	D_2 correction
Fe	248.3	25	0.2	20	Ar (3 sec, normal flow, 20)	Dry: 110°C, 22 sec. Char: 1100°C, 22 sec. Atomize: 2700°C, 7 sec.	0.5	1.5	10	30	D_2 correction
Pb	283.3	10	0.7	20	Ar (3 sec, normal flow, 20)	Dry: 110°C, 22 sec. Char: 750°C, 22 sec. Atomize: 2300°C, 7 sec.	0.5	10	1	20	D_2 correction
Sr	460.7	20	0.2	20	Ar (3 sec, normal flow, 20)	Dry: 110°C, 22 sec. Char: 800°C, 22 sec. Atomize: 2700°C, 22 sec.	1	20	1.5	30	No D_2 correction
Zn	213.9	15	0.7	10	Ar (3 sec, normal flow, 20)	Dry: 110°C, 22 sec. Char: 500°C, 22 sec. Atomize: 2500°C, 7 sec.	0.1	1	0.3	3	D_2 correction Environmental Contamination

TABLE 5. Instrument Operating Conditions and Detection Limits for Metals Analyzed by Flame Atomic Absorption Spectrophotometry

Element	Wavelength (nm)	Lamp Current (mA)	Slit Width (nm)	Gas Oxidant/Fuel	Flame Type	Minimum Detection Limit(ppm)	Sensitivity (ppm/0.0044 Abs)	Additional Comments
Al	309.3	20	0.7	N_2O/C_2H_2	Reducing	0.5	2.0	D_2 correction
Ba	55	25	0.2	N_2O/C_2H_2	Reducing	0.5	1.5	No D_2 correction
Ca	422.7	10	0.7	Air/C_2H_2	Oxidizing	0.01	0.1	No D_2 correction Environmental contamination $LaCl_3$ matrix used
Cd	228.8	4	0.7	Air/C_2H_2	Oxidizing	0.01	0.03	D_2 correction
Cr	357.9	8	0.7	Air/C_2H_2	Reducing	0.03	0.1	D_2 correction
Cu	324.7	10	0.7	Air/C_2H_2	Oxidizing	0.04	0.1	D_2 correction
Fe	248.3	25	0.7	Air/C_2H_2	Oxidizing	0.02	0.15	D_2 correction
Pb	283.3	10	0.7	Air/C_2H_2	Oxidizing	0.2	0.6	D_2 correction
Sr	460.7	20	0.2	N_2O/C_2H_2	Reducing	0.02	0.1	No D_2 correction $LaCl_3$ matrix used
Zn	213.9	15	0.7	Air/C_2H_2	Oxidizing	0.015	0.02	D_2 correction Environmental contamination

Figure 1 summarizes the analytical scheme used for metals determination. All elemental concentrations are reported in as mass of component per unit dry weight of whole drilling fluid. Water content data are available to convert these data to mass of metal per unit volume of wet mud. Table 6 presents accuracy and precision data for metals analyzed for.

Particulate Bioassay Phase

The 50-ml aliquots removed from the one-hour syphonates described above were subjected to a 6N HNO_3 leach described in EPA's Methods for Water and Wastewater(2). After heating and being allowed to cool and settle, each acid leachate was decanted off into a 25-ml graduated cylinder and brought to volume with 1.0 N HNO_3. Analyses followed using flame and flameless atomic absorption as described for whole drill fluids. In this case, barium was also analyzed for by atomic absorption spectrophotometry as opposed to neutron activation analysis.

Dissolved Bioassay Phase

The dissolved bioassay phases, prepared by 72-hour settling in seawater, centrifugation and filtering, were analyzed for heavy metal contents in the same manner as described above for the particulate bioassay phase. Again, atomic absorption was utilized for barium rather than neutron activation.

FIGURE 1. Analytical Scheme for Metals in Drill Muds

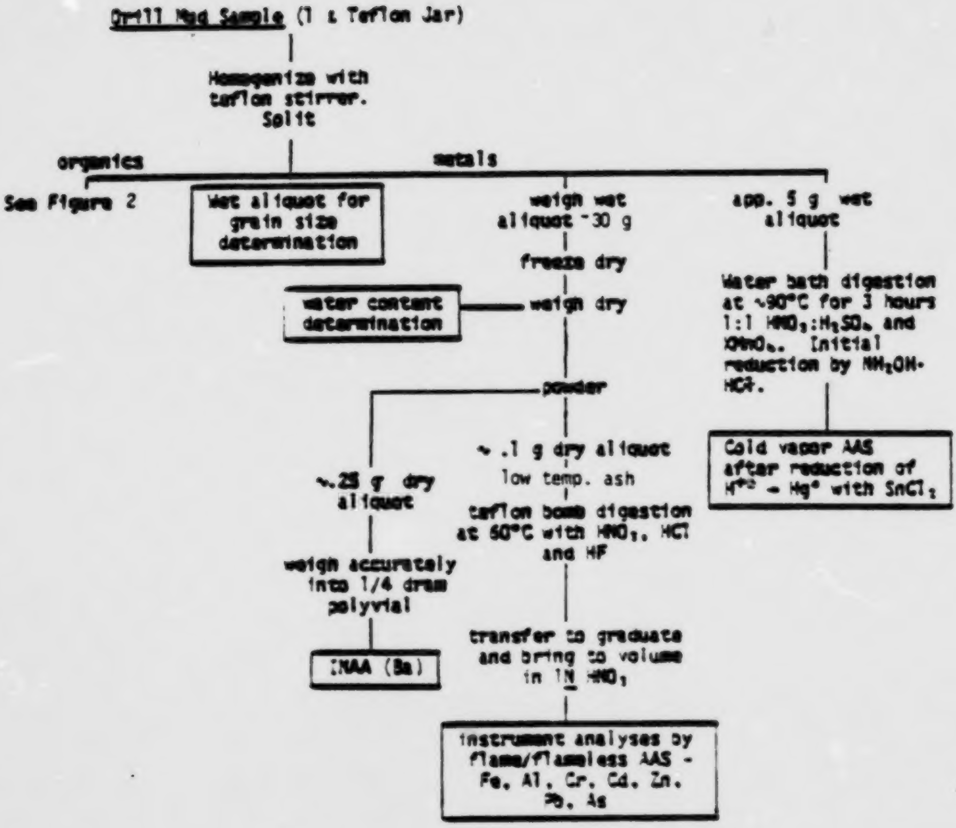

Drill Mud Sample (1 ℓ Teflon Jar)
Homogenize with teflon stirrer. Split
organics
metals
See Figure 2
Wet aliquot for grain size determination
weigh wet aliquot ~30 g
freeze dry
water content determination
weigh dry
powder
~.25 g dry aliquot
weigh accurately into 1/4 dram polyvial
INAA (Ba)
~ .1 g dry aliquot
low temp. ash
teflon bomb digestion at 60°C with HNO_3, HCl and HF
transfer to graduate and bring to volume in 1N HNO_3
instrument analyses by flame/flameless AAS - Fe, Al, Cr, Cd, Zn, Pb, As
app. 5 g wet aliquot
Water bath digestion at ~90°C for 3 hours 1:1 HNO_3:H_2SO_4 and $KMnO_4$. Initial reduction by $NH_2OH \cdot HCl$.
Cold vapor AAS after reduction of $Hg^{+2} \rightarrow Hg^{\circ}$ with $SnCl_2$

TABLE 6. Trace Metal Sample Accuracy and Precision (Concentrations in µg/g dry weight unless otherwise indicated)

Element[a]	River Sediment (SRM-1645)	River Sediment (SRM-1645)	Estuarine Sediment (SRM-1646)	Estuarine Sediment (SRM-1646)	**Determined C.V.%**	
	N.B.S.	Determined	N.B.S.	Determined	**SRM-1645**	**SRM-1646**
Al	—	—	(%) 6.25 ± 0.2	(%) 6.03 ± 0.1	—	2
Ca	—	—	(%) 0.83 ± 0.03	(%) 0.86 ± 0.02	—	2
Cd	10.2 ± 1.5	10.8 ± 0.5	0.36 ± 0.07	0.29 ± 0.03	5	10
Cr	(%) 2.96 ± 0.28	(%) 3.02 ± 0.05	76 ± 3	60 ± 2	2	3
Cu	109 ± 19	107 ± 1	18 ± 3	17 ± 1	1	6
Fe	(%) 11.3 ± 1.2	(%) 10.7 ± 0.2	(%) 3.35 ± 0.1	(%) 3.47 ± 0.05	2	1
Pb	714 ± 28	728 ± 33	28.2 ± 1.8	28.6 ± 2.5	5	6
Zn	1720 ± 169	1588 ± 18	138 ± 6	121 ± 4	1	3

[a] Mean values obtained from n=5 analyses

C. Organic Analysis Procedures

Whole Drill Muds

Each sample was weighed wet to the nearest mg and an aliquot withdrawn for dry weight (percent water) determination. Each sample was then extracted, dried with a methanol/shaker table agitation procedure, and the dewatered samples further extracted with methanol/methylene chloride. The methanol used for the initial water removal step was back-extracted with hexane and the combined organic extracts, then further back-extracted with saturated sodium chloride solution to remove residual water from the organic phases. The saturated sodium chloride was then back-extracted with methylene chloride (3 times) to ensure removal of all the organic components of interest.

Each combined hexane and methylene chloride fraction was then passed through a sodium sulfate drying column to remove the last traces of water, and then solvent exchanged to hexane in preparation for fractionation by column chromatography. Fraction 1 (F1), a hexane eluant of the components of interest, contained primarily aliphatic hydrocarbons and PCBs; Fraction 2 (F2, a 1:1 hexane:benzene eluant) contained aromatic hydrocarbons ranging from toluene to polynuclear aromatics, such as dibenzochrysenes and perylene (F2 also contains several pesticides and herbicides of intermediate polarity); and Fraction 3 (F3, 1:1 methylene chloride:methanol eluant) contained primarily polar esters, phenols, carboxylic acids and more polar pesticides and herbicides.

Each of the fractions obtained with the extraction procedure was analyzed by capillary column gas chromatography, utilizing two detection techniques. Flame ionization detection was used to screen for aliphatic and aromatic hydrocarbons and the more polar phenol, carboxylic acid and ester components. These analyses allowed determination of petroleum contaminants in the drilling mud samples. These same extracts were subjected to electron capture capillary gas chromatography, providing a screen of chlorinated hydrocarbons such as PCBs and biocides including a variety of chlorinated pesticides and herbicides as well as phosphorous and nitrogen and/or sulfur containing compounds. Fractions of particular interest were then subjected to additional analyses by gas chromatography/mass spectrometry, providing individual compound verification.

All gas chromatographic data were recorded and reduced to digital format by computerized data reduction programs, and all concentrations of resolved component peaks have been reported on a microgram (or nanogram) per liter of bulk drilling mud samples. Water content measurements were made so that conversions of concentration data to dry weight base can be made; these data are included in the elemental analysis results for each whole mud.

Figure 2 summarizes the analytical scheme used for organic measurement.

Particulate Bioassay Phase

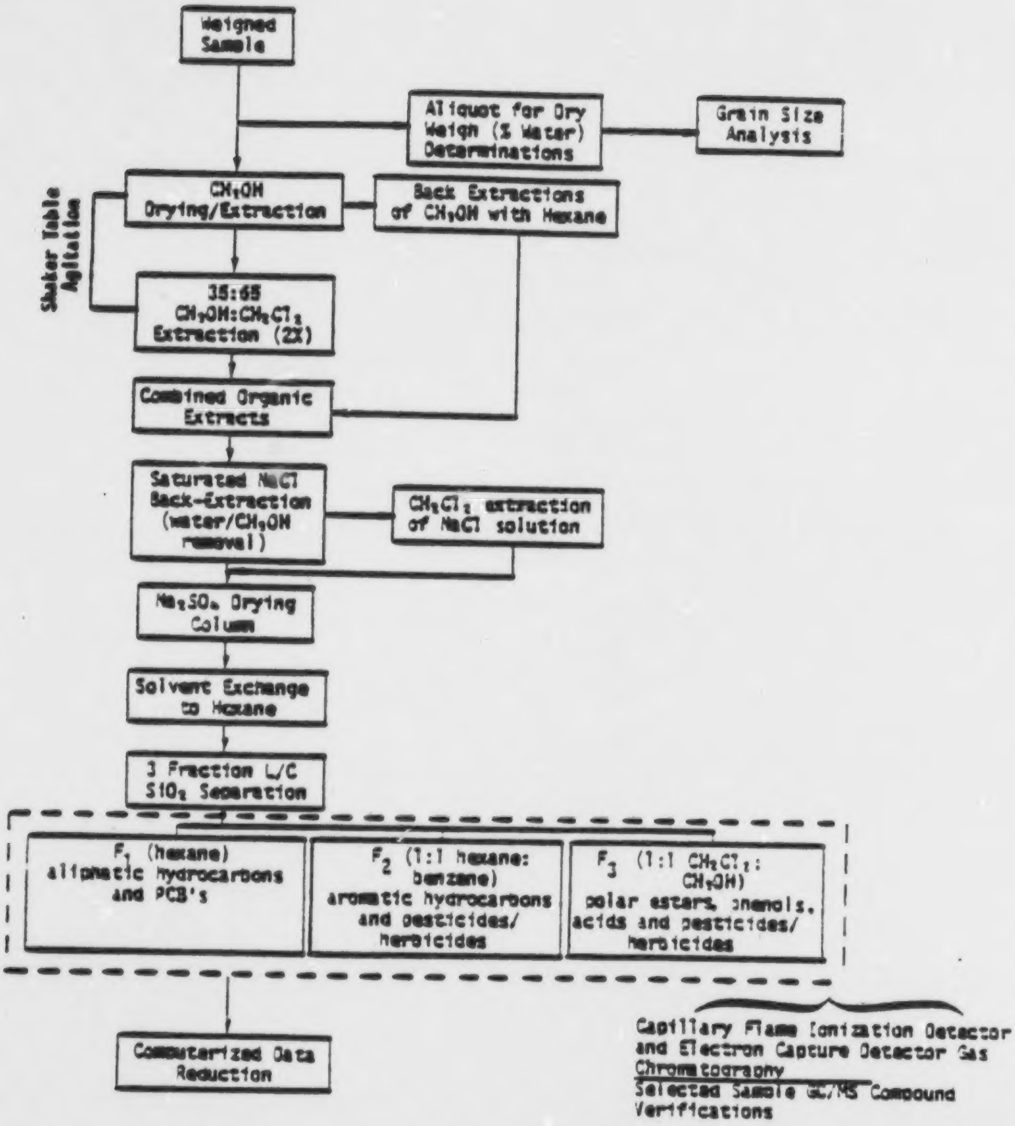
The sample phases obtained after one hour settling in seawater were subjected to continuous liquid/liquid extraction for 24 hours using methylene chloride. Deionized water was added to each sample volume (which was approximately 500 ml in each case) prior to beginning extraction to provide sufficient volume for the extractors to operate. Also, reagent grade sulfuric acid was added to each sample to bring its pH to less than 2 prior to extraction.

After 24 hours, each sample extract in methylene chloride was concentrated to 1.0 ml using a Kuderna-Danish apparatus. Each concentrate then underwent two solvent exchanges with 3 to 5 ml of hexane, and fractionated over activated silica gel in a 1-cm x 19-cm column. Three fractions were obtained:

F1 - after 30 ml of hexane
F2 - after 45 ml of benzene/hexane (1:1)
F3 - after 60 ml of methanol/methylene chloride (1:1)

Each fraction was concentrated a final time to volumes ranging from 0.25 ml to 1.0 ml by Kuderna Danish techniques.

FIGURE 2. Analytical Scheme for Organics in Drill Muds


Weighed Sample
Aliquot for Dry Weigh (% Water) Determinations
Grain Size Analysis
Shaker Table Agitation
CH_3OH Drying/Extraction
Back Extractions of CH_3OH with Hexane
35:65 $CH_3OH:CH_2Cl_2$ Extraction (2X)
Combined Organic Extracts
Saturated NaCl Back-Extraction (water/CH_3OH removal)
CH_2Cl_2 extraction of NaCl solution
Na_2SO_4 Drying Column
Solvent Exchange to Hexane
3 Fraction L/C SiO_2 Separation
F_1 (hexane) aliphatic hydrocarbons and PCB's
F_2 (1:1 hexane: benzene) aromatic hydrocarbons and pesticides/herbicides
F_3 (1:1 CH_2Cl_2: CH_3OH) polar esters, phenols, acids and pesticides/herbicides
Computerized Data Reduction
Capillary Flame Ionization Detector and Electron Capture Detector Gas Chromatography
Selected Sample GC/MS Compound Verifications

After final concentration, a three fraction analytical scheme using GC and GC/MS instrumentation was performed as described above for the whole drill fluid fraction.

Dissolved Bioassay Phase

The dissolved bioassay phase, obtained for each sample after 72 hour settling in seawater, centrifuging and filtering, was extracted and concentrated just as described above for the particulate bioassay phase. However, after solvent exchange to hexane and final volume concentration to 100-300 ul, no further fractionation was performed prior to GC and GC/MS analyses.

D. Data Presentation

Concentration Data

For each whole drilling fluid sample, heavy metal concentrations are expressed as mass of metal per unit mass of dry sediment (usually ug/g dry weight; weight percent for Al, Ba, Ca, Fe). Table "A" for each sample contains these data and includes a water content value (expressed as weight percent). Whole drilling fluid heavy metal concentrations may be changed from dry weight basis (i.e., ug/g dry mud or weight percent) to wet weight values (i.e., ug/g wet fluid) by the following conversion:

$$\text{ug metal/g bulk drill fluid} = \frac{\text{ug metal}}{\text{g dry mud}} \cdot \frac{\text{g dry mud}}{\text{g bulk drill fluid}}$$

$$= \frac{\text{ug metal}}{\text{g dry mud}} \cdot [1-(\text{percent } H_2O/100)]$$

To express as mass of metal per volume of whole mud requires an estimate of bulk fluid density which can be made by:

$$\text{bulk mud density (g/ml)} = \frac{\text{g bulk drill fluid}}{\text{ml } H_2O + \text{ml dry mud}}$$

$$\text{where ml } H_2O = \text{g } H_2O/\text{density } H_2O$$

$$= \frac{\%\ H_2O\ \text{g}}{100} \Big/ (1\ \text{g/ml})$$

$$\text{ml dry mud} = \text{g dry mud/density dry mud}$$

$$= \frac{(100-\%H_2O)\ \text{g}}{100} \Big/ (2.5\ \text{g/ml})$$

Conversion from mass of bulk drill fluid (wet) to volume of bulk drill fluid can then be made by:

$$\text{volume bulk drill fluid} = \text{mass bulk drill fluid/density bulk drill fluid}$$

This last conversion from mass of metal/mass of bulk drill fluid to mass of metal/volume of bulk drill fluid can be used to relate the mass/volume concentrations of metals in the particulate and dissolved bioassay phases (which were produced by adding measured (to the nearest ml) volumes of drill fluid to form seawater suspensions) to the concentrations in each original bulk fluid.

All hydrocarbon concentrations are expressed in mass of component/volume of bulk drill fluid (or volume of final bioassay phase). As just described for heavy metal contents, conversions can be made between mass/volume, mass/dry mass and mass/wet mass concentrations using the measured water contents and an assumed dry mud density of 2.5 g/ml (g/cm^3).

Comparison With No. 2 Fuel Oil Analysis

In a companion report prepared by New England Aquarium (NEA)(4), whole drilling fluids were also analyzed for hydrocarbon content, but a slightly different analytical approach was used. Although several differences exist in the sample extraction protocols, they probably account for only relatively subtle differences in qualitative and quantitative results. Most important is that the analytical hydrocarbon content data in this report were derived from identification and quantitation of all individual components recognizable by a combination of GC-FID and GC/MS; the approach taken in the NEA study(4) was to identify and quantitate only select components common to a No. 2 fuel oil standard. A set of dominant chromatographic peaks found in the No. 2 fuel oil standard were selected from each sample's profile, quantitated and summed.

In general, results from the two analytical approaches correlate well with each other producing a coherent trend in "hydrocarbon-type" contents among the production muds characterized. Figure 3 plots the independently derived concentrations of petroleum hydrocarbons (PHCs), as well as the water contents of each sample. Although the muds used by both laboratories were from common sources, the measured water contents of each sample set were of the same trend but different in value; since NEA's data are reported in mg/g wet weight and SAI's in mg/ml, variations in water content are important. With the exception of mud P3, the two sets of data are comparable over a broad range of hydrocarbon content levels.

Conversion of the two sets of data to common concentration units (mg/ml or mg/g wet), as explained in the preceding discussion, removes most of the numerical variance between them. However, there is a significant, although very consistent, variation in water contents between the two sets of samples (see Figure 3 and Table 7) which is a factor in attempting to normalize the data.

Table 8 compares, for each drill mud characterized, petroleum hydrocarbon concentrations for whole, suspended and dissolved phases (prepared as described for bioassay testing). In general, the three phases trend in accordance to the levels measured in the whole mud phase; notable exceptions are a relatively high dissolved concentration for SV 76-2-5 and a relatively low dissolved phase level for P-1. Presumably, these

FIGURE 3. Petroleum Hydrocarbon Concentrations (mg/ml whole mud) and Water Contents (%) from this Study vs No. 2 Fuel Oil Concentrations (mg/g wt. weight) and Water Contents from NEA(4). Data are for whole muds.

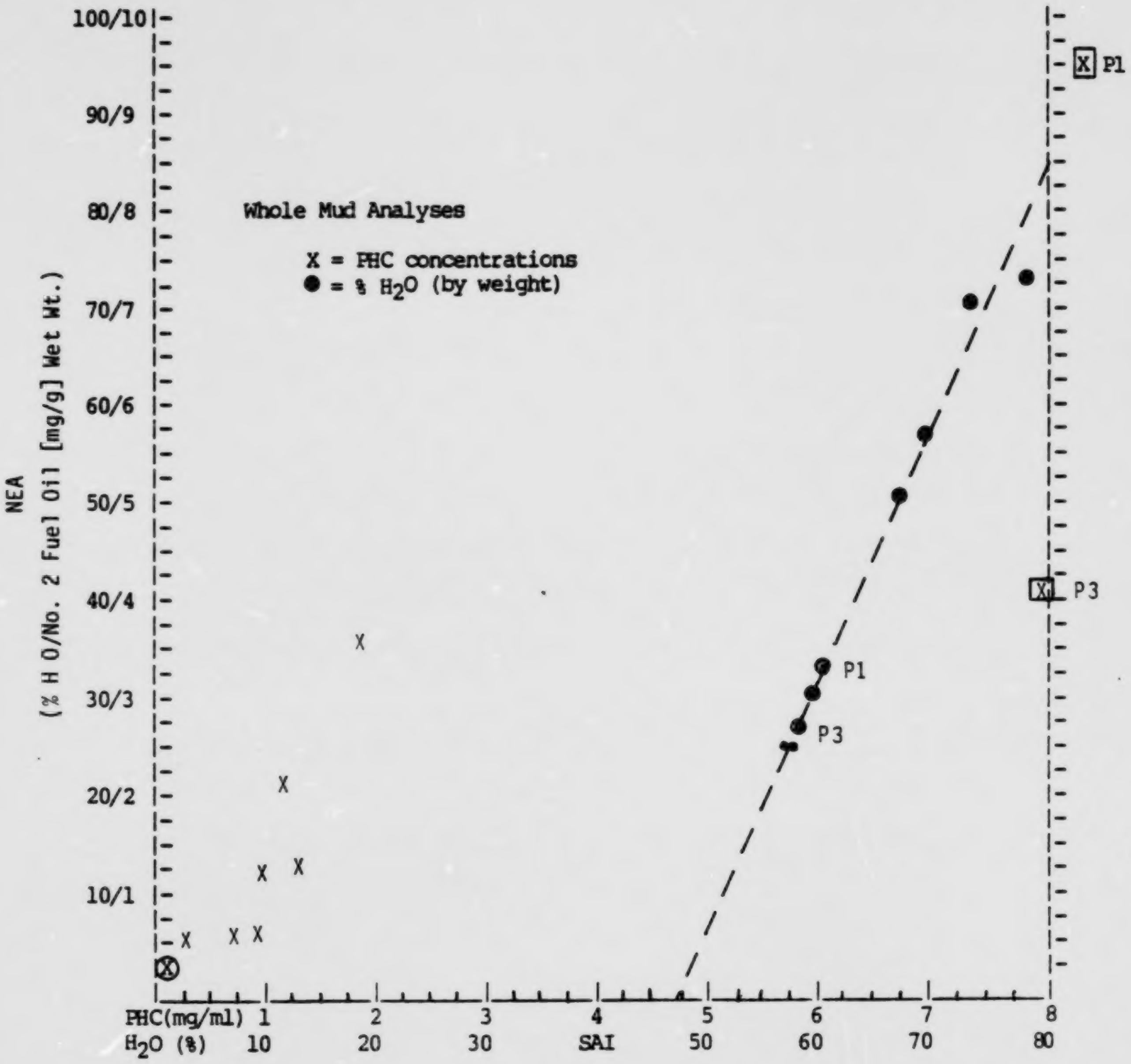


TABLE 7. Comparative Whole Mud Hydrocarbon Concentration and Water Content Data

Sample ID	SAI(mg/ml)	SAI %H_2O	NEA(mg/g wet)	NEA %H_2O
AN31	0.90	66.7	1.18	49.9
MIBLKA51	0.06	75.8	0.19	69.5
SV 76-2-5	1.93	58.1	3.59	27.3
P-1	8.50	59.9	9.43	33.8
P-2	1.33	58.8	2.14	30.0
P-3	7.91	57.8	3.98	26.8
P-4	0.89	60.2	0.67	33.5
P-5	1.32	57.5	1.41	26.3
P-6	0.03	78.1	0.10	71.5
P-7	0.14	69.9	0.50	57.0
P-8	0.72	58.1	0.56	27.3

TABLE 8. Comparative Hydrocarbon Concentrations in Whole, Suspended and Dissolved Drilling Mud Phases. SAI data are based on total resolved and unresolved aliphatic and aromatic hydrocarbons; NEA data are based on chromatographic comparison with No. 2 fuel oil standards.

Sample ID	SAI Whole Mud (mg/l)	SAI Suspended (mg/l)	SAI Dissolved (mg/l)	NEA Suspended (mg/l)
MIBLKA51	60	0.12	1.17	0.09
AN31-1-6	900	0.42	1.38	0.61
SV 76-2-5	1930	4.43	7.55	2.10
P-1	8500	19.7	0.96	2.55
P-2	1330	1.12	0.01	0.24
P-3	7910	18.7	7.58	1.23
P-4	890	0.90	0.01	0.10
P-5	1320	5.11	1.33	0.13
P-6	30	0.08	0.04	ND
P-7	140	0.09	0.18	0.07
P-8	730	3.08	2.58	0.36

variations are related to the exact nature of the dominant hydrocarbon components and their varying solubilities are particle/dissolved partitioning characteristics. NEA(4) suspended phase hydrocarbon concentrations are also included in Table 8; the significantly lower values result from using selected aromatics in No. 2 fuel oil to quantitate these samples rather than quantitating from total resolved and unresolved components.

References

(1)U.S. EPA Region II Drilling Mud Bioassay Test Procedures

(2)EPA Methods for Chemical Analysis of Water and Wastes Method 200-4.1.1 through 4.1.3 (In: EPA-600/4-79-020)(March 1979).

(3)Standard Methods for Examination of Water and Wastewater, 15th Edition, Methods 300D, 303A, 303C and 304 (American Public Health Association: Washington, D.C.)(1980).

(4)A Survey of the Toxicity and Chemical Composition of Used Drilling Muds. Final Report, Cooperative Agreement No. CR806776. New England Aquarium, August 1, 1983.

III. MUD IDENTIFICATION: MIBLKA51

LAB NUMBER 83-323

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

III A. DRILLING MUD ELEMENTAL CONCENTRATIONS

MIBLKA51 A1-7 (Sample I.D.: 83-323)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	5.19(%)	473.	0.026
Ba	9.85(%)	13.9	0.409
Cd	0.387	0.007	0.001
Ca	4.39(%)	—	—
Cr	337.	5.76	0.338
Cu	23.4	0.349	0.000
Fe	4.31(%)	546.	0.295
Pb	135.	1.41	0.011
Sr	510.	—	—
Zn	161.	2.76	0.001
H_2O	75.8(%)	—	—

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[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

IIIB. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

III B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	$N\text{-}C_9$	$N\text{-}C_{10}$	$N\text{-}C_{11}$	$N\text{-}C_{12}$	$N\text{-}C_{13}$	$N\text{-}C_{14}$	$N\text{-}C_{15}$	$N\text{-}C_{16}$	$N\text{-}C_{17}$	Pristane	$N\text{-}C_{18}$	Phytane	$N\text{-}C_{19}$
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

III B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
4IBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

III B. (cont). MIBLKA51 A1-7 WHOLE DRILLING FLUID FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (ug/l)[a]
Methylethylbenzene	960	42.2
Trimethylbenzene	991	37.6
Naphthalene	1179	13.9
2-Methylnaphthalene	1289	177.
1-Methylnaphthalene	1306	68.3
1,1'-Biphenyl	1375	20.4
*Dimethylnaphthalene	1400	241.
*Dimethylnaphthalene	1415	134.
*Dimethylnaphthalene	1434	56.1
Methyl-1,1'-biphenyl	1483	104.
Methylethylnaphthalene	1500	136.
*Trimethylnaphthalene	1522	74.8
*Trimethylnaphthalene	1527	135.
*Trimethylnaphthalene	1544	28.5
*Trimethylnaphthalene	1578	27.4
*Trimethylnaphthalene	1560	194.
*Methyl-(methylethyl)-Naphthalene	1647	53.1
*Methyl-(methylethyl)-Naphthalene	1668	92.5
Phenanthrene	1775	162.
Methyldibenzothiophene	1849	35.8
*Methylphenanthrene	1890	113.
*Methylphenanthrene	1915	72.7
*Methylphenanthrene	1904	13.5
*Dimethylphenanthrene	2011	32.9
*Dimethylphenanthrene	2030	96.1
*Dimethylphenanthrene	2037	24.9

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentration expressed per unit volume of wet sample.

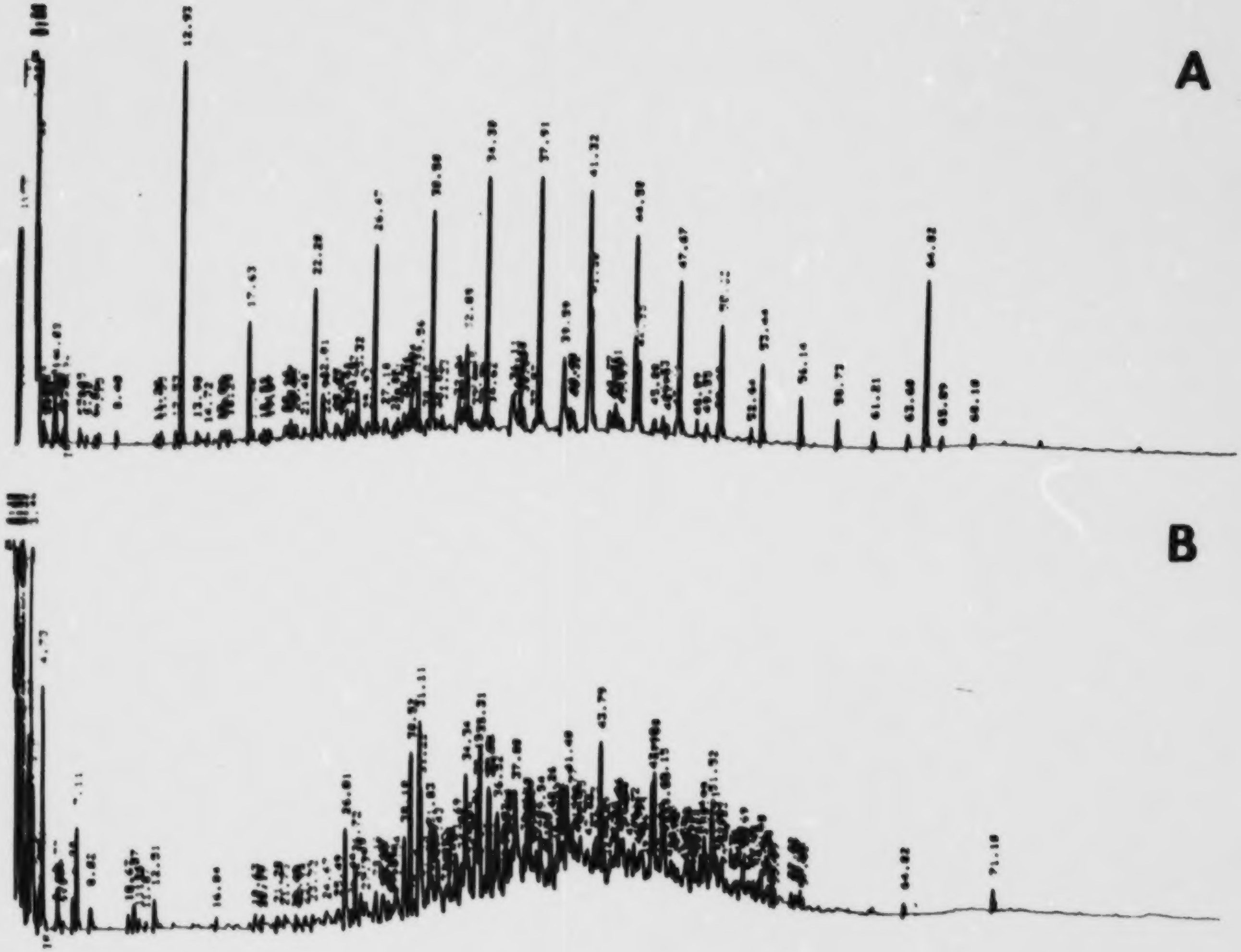


FIGURE III B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID MIBLKA51 A1.

IIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

IIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	$N\text{-}C_9$	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

IIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

IIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC$_{23}$	NC$_{24}$	NC$_{25}$	NC$_{26}$	NC$_{27}$	NC$_{28}$	NC$_{29}$	NC$_{30}$	NC$_{31}$	NC$_{32}$
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

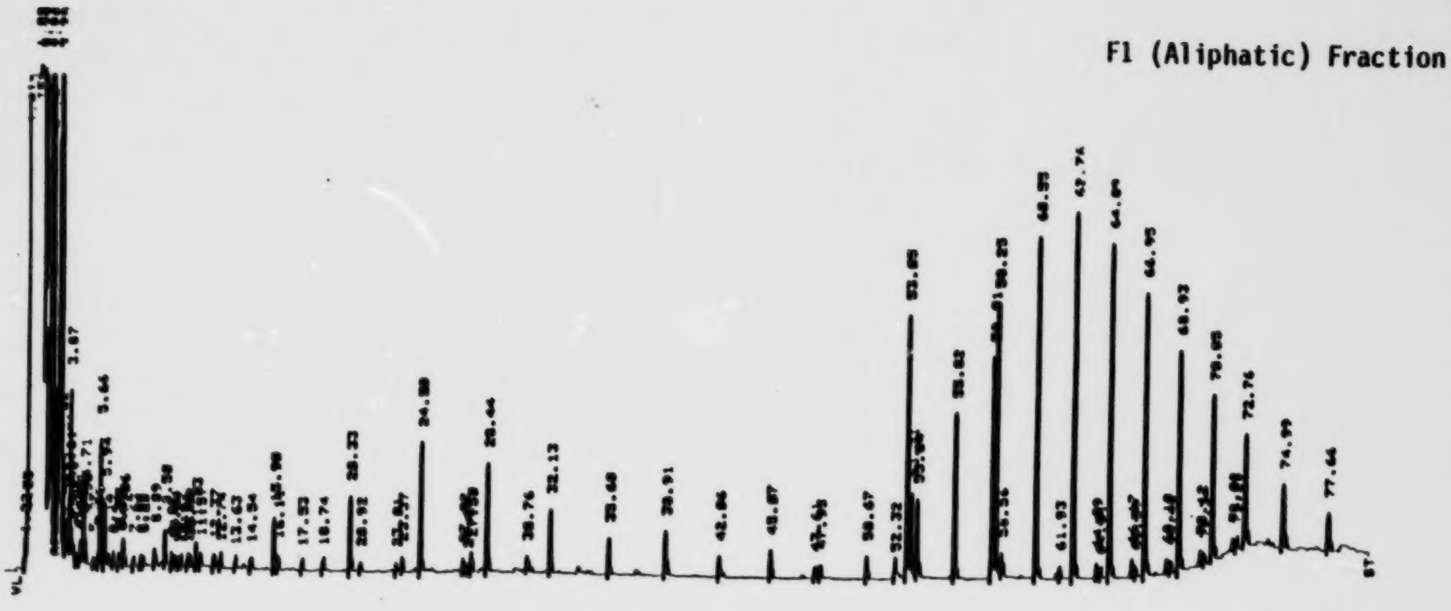


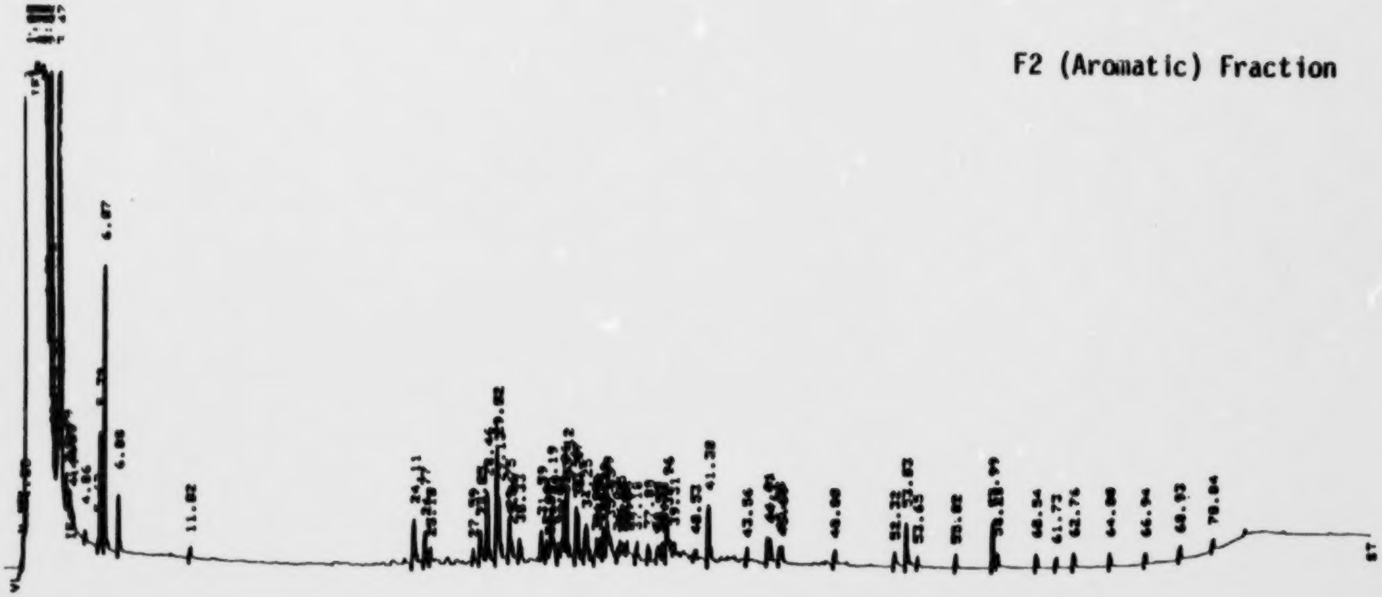
FIGURE III C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MIBLKA51 A1-7.

IIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

IIIC. MIBLKA51 A1-7 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
2-Methylnapthalene	1290	0.46
1-Methylnapthalene	1306	0.25
*Dimethylnapthalene	1400	0.60
*Dimethylnapthalene	1415	0.56
*Dimethylnapthalene	1435	0.16
Methyl-1, 1'-biphenyl	1485	0.22
Menthylethylnaphalene	1502	0.23
*Trimethylnaphthalene	1524	0.22
*Trimethylnaphthalene	1528	0.34
*Trimethylnaphthalene	1544	0.19
*Trimethylnaphthalene	1561	0.57
*Methyl-(methylethyl)-Naphthalene	1668	0.10
Phenanthrene	1775	0.45
*Methylphenanthene	1891	0.14



F2 (Aromatic) Fraction

FIGURE III C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MIBLKA51 A1-7.

IIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (µg/l)	Unresolved (µg/l)	Total (µg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

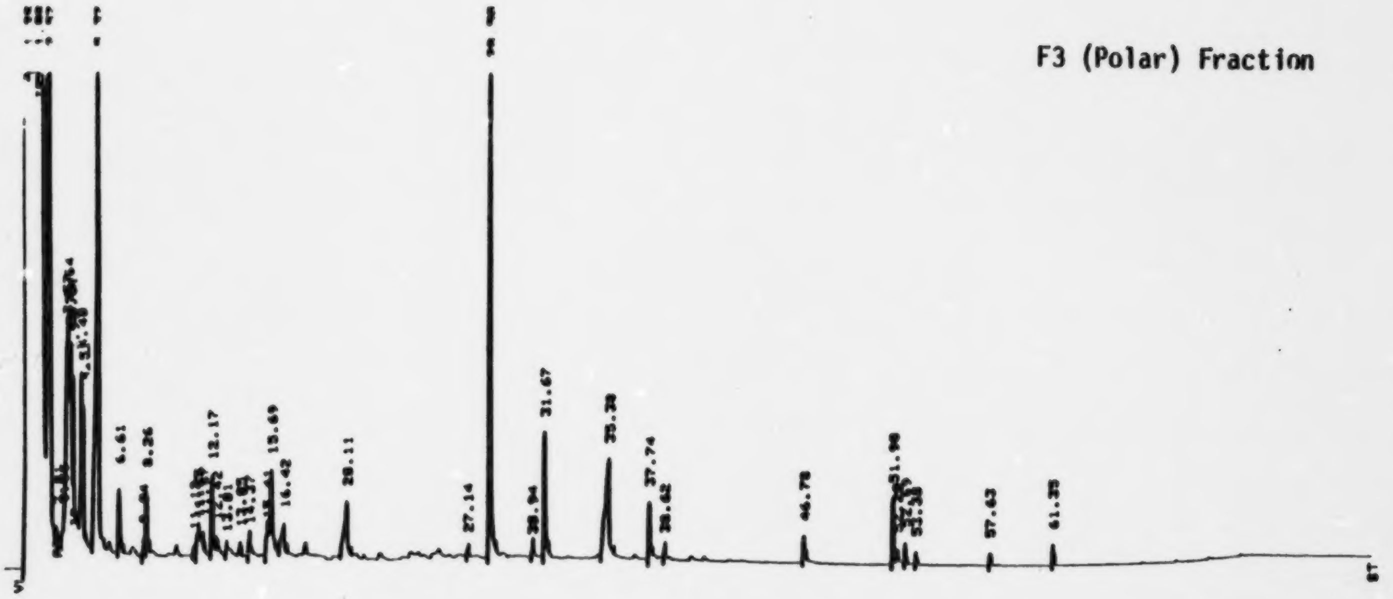


FIGURE IIIC. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MIBLKA51 A1-7.

IIID. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/1)	Total Unresolved Components (mg/1)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

IIID (cont). MIBLKA51 A1-7 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l)
C_7-Alcohol	911	1.4
C_8-Alcohol	1023	26.0
Ethylhexanol	1041	1.6
C_9-Ketone	1065	1.0
Benzoic Acid	1223	5.8
C_{13}-Ketone	1495	.2
Molecular Ion m/e = 170	1552	3.5
Molecular Ion m/e = 199	1676	5.2
C_{18}-Alcohol	2081	.8
C_{18}-Carboxylic Acid	2168	.8
C_{19}-Carboxylic Acid	2302	.2
C_{20}-Carboxylic Acid	2445	6.5

*Concentrations expressed per unit volume of wet sample.

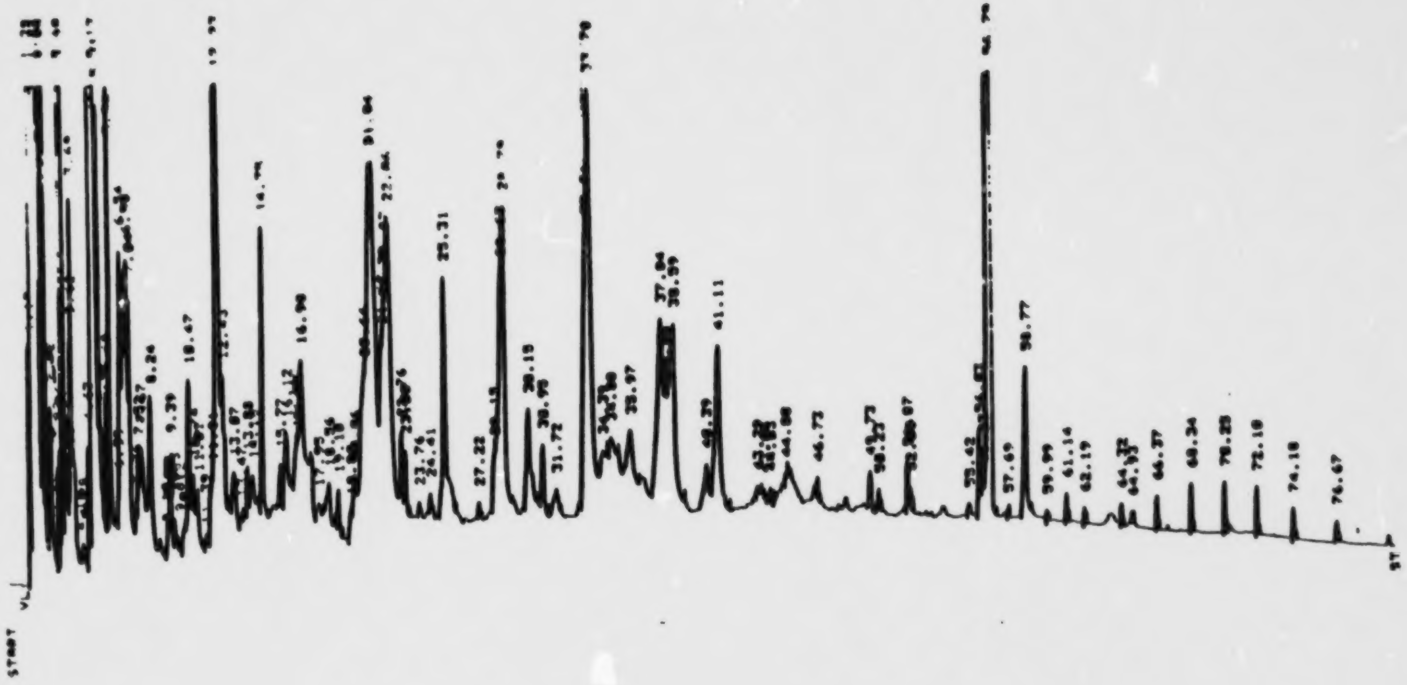


FIGURE IIID. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MIBLKA51 A1.

IV. MUD IDENTIFICATION: AN 31-1-6

LAB NUMBER 83-324

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

IV A. DRILLING MUD ELEMENTAL CONCENTRATIONS

AN 31-1-6 (Sample I.D.: 83-324)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparatio
Al	3.74(%)	1206.	0.079
Ba	21.8(%)	15.0	0.469
Cd	2.38	0.076	0.005
Ca	1.57(%)	—	—
Cr	774.	828.	1.15
Cu	33.6	2.56	0.098
Fe	2.68(%)	1565.	1.09
Pb	142.	1.20	0.040
Sr	538.	—	—
Zn	247.	14.5	0.526
H_2O	66.7 (%)	—	—

[a] Concentrations expressed as µg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as µg/g wet weight unless otherwise indicated.

IV B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

IV B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

IV B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

IV B (cont.) AN31-1-6 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Methylethylbenzene	959	77.8
*Trimethylbenzene	991	164.
*Trimethylbenzene	1020	136.
*Methylpropylbenzene	1050	157.
*Dimethylethylbenzene	1057	111.
*Methylpropylbenzene	1065	75.2
*Dimethylethylbenzene	1083	251.
Methyl-(methylethyl)-benzene	1103	177.
Dimethylpropylbenzene	1114	306.
*Tetramethylbenzene	1118	207.
Methylpropenylbenzene	1144	383.
*Tetramethylbenzene	1147	92.8
Naphthalene	1180	391.
2-Methylnaphthalene	1291	2720.
1-Methylnaphthalene	1308	3600.
1,1'-Biphenyl	1392	3845.
*Dimethylnaphthalene	1418	3082.
*Dimethylnaphthalene	1403	4130.
*Dimethylnaphthalene	1434	478.
*Dimethylnaphthalene	1448	202.
Methyl-1,1'-biphenyl	1485	1790.
Me~~thylethyl~~naphthalene	1504	1570.
*Trimethylnaphthalene	1526	1320.
*Trimethylnaphthalene	1531	2560.
*Trimethylnaphthalene	1547	739.
*Trimethylnaphthalene	1564	727.
*Trimehtylnaphthalene	1582	1100.
*Methyl-(methylethyl)-Naphthalene	1651	923.
*Methyl-(methylethyl)-Naphthalene	1672	1110.
Phenanthrene	1781	872.
Methyldibenzothiophene	1856	761.
*Methylphenanthrene	1897	794.
*Methylphenanthrene	1922	1160.
*Dimethylphenanthrene	2019	464.
*Dimethylphenanthrene	2038	1010.
*Dimethylphenanthrene	2044	351.

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

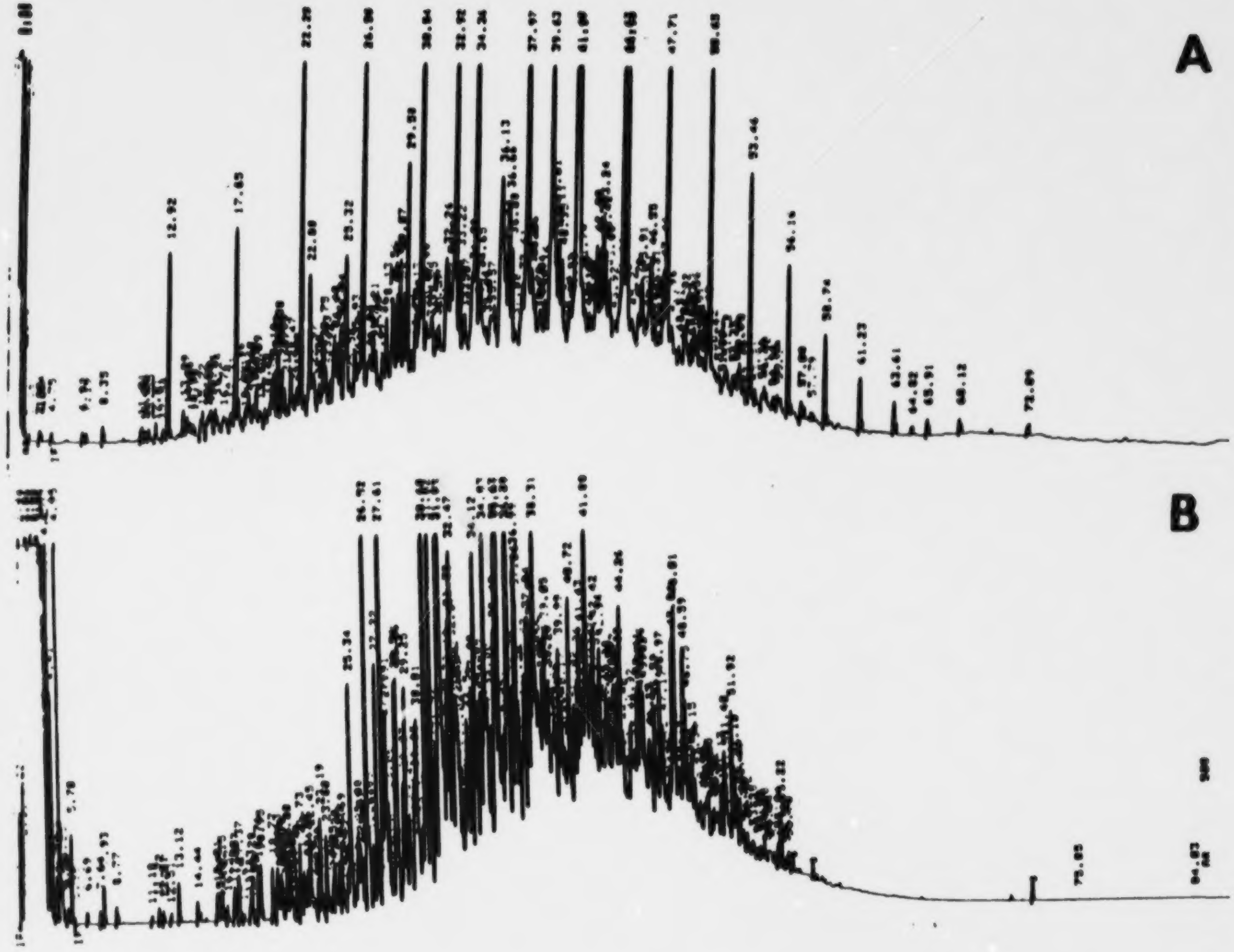


FIGURE IV B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID AN31-1-6.

IV C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

IV C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

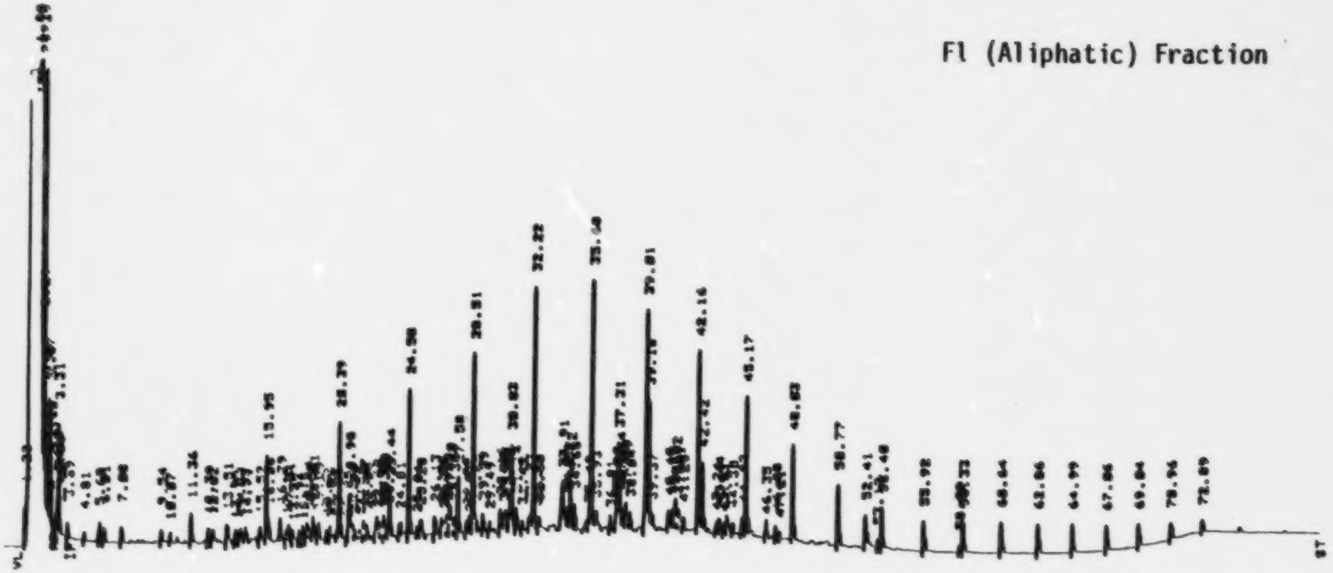
Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

IV C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

IV C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS ($\mu g/l$)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—



F1 (Aliphatic) Fraction

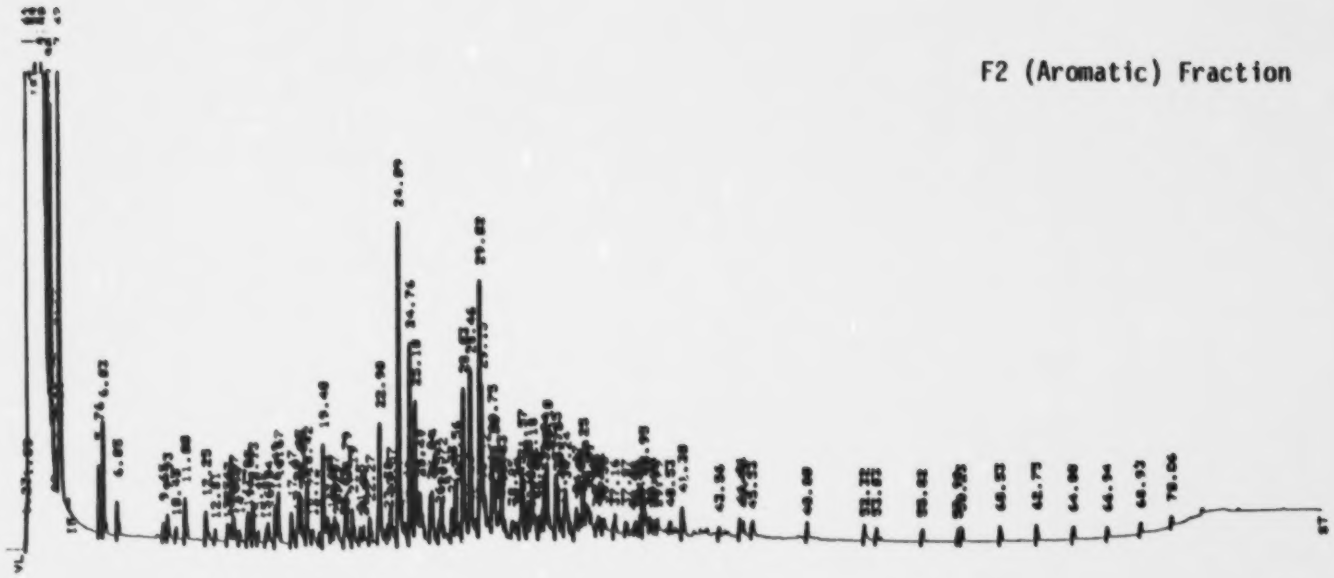
FIGURE IV C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID AN 31-1-6.

IVC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

IVC. AN 31-1-6 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATION

Compound Name	KOVAT #	Concentration (μg/l)
*Trimethylbenzene	991	0.38
*Trimethylbenzene	1020	0.38
*Dimethylethylbenzene	1083	0.39
Methyl-(methylethyl)-benzene	1103	0.14
Dimethylpropylbenzene	1112	0.37
*Tetramethylbenzene	1116	0.32
Methylpropropenylbenzene	1145	0.34
Naphthalene	1178	1.1
2-Methylnaphthalene	1290	5.0
1-methylnaphthalene	1306	2.6
*Dimethylnaphthalene	1419	0.63
*Dimethylnaphthalene	1400	2.5
*Dimethylnaphthalene	1435	0.63
Methyl-1,1'-biphenyl	1485	0.55
Methylethylnaphthalene	1501	0.39
*Trimethylnaphthalene	1528	0.50
*Trimethylnaphthalene	1546	0.16



F2 (Aromatic) Fraction

FIGURE IV C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID AN 31-1-6.

IV C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

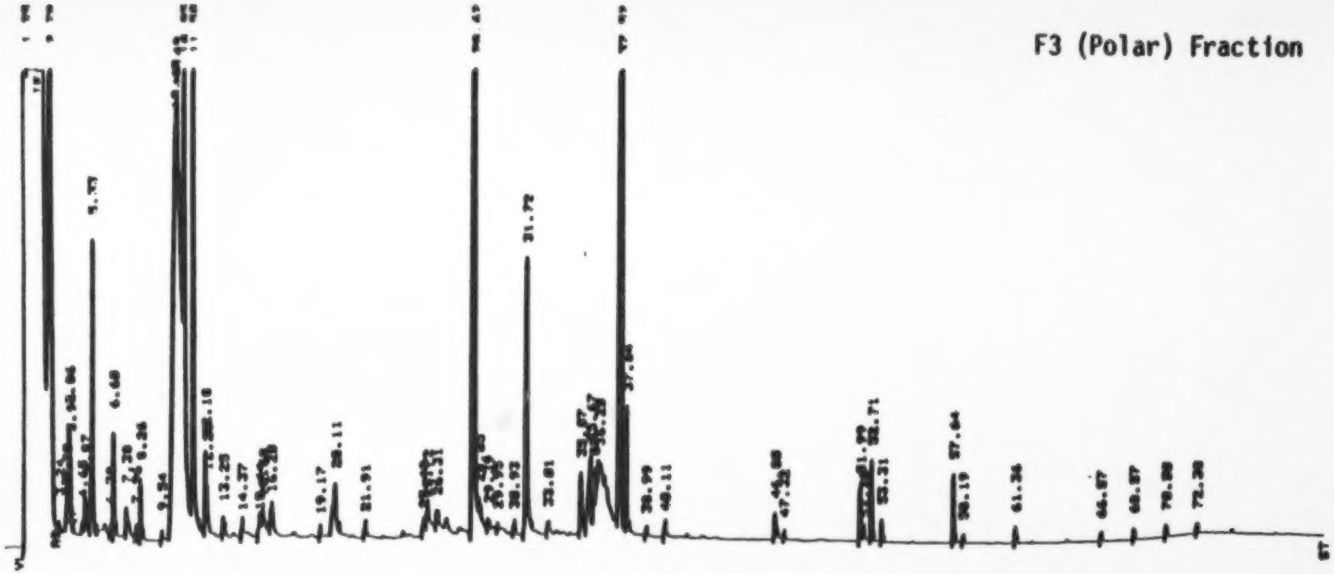


FIGURE VI C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID AN 31-1-6.

IV D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

IV D. (cont.) AN31-1-6 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
C_7-Alcohol	910	2.1
C_8-Alcohol	1023	11.4
Benzoic Acid	1214	.9
Methoxybenzaldehyde	1418	2.5
C_{13}-Ketone	1500	1.0
Molecular Ion m/e = 170	1552	.5
Methoxybenzoic Acid	1591	4.1
Molecular Ion m/e = 199	1681	20.8
Hexadecanoic Acid	1984	2.3
C_{18}-Carboxylic Acid	2164	.6
C_{20}-Carboxylic Acid	2454	3.5

[a] Concentrations expressed per unit volume of wet sample.

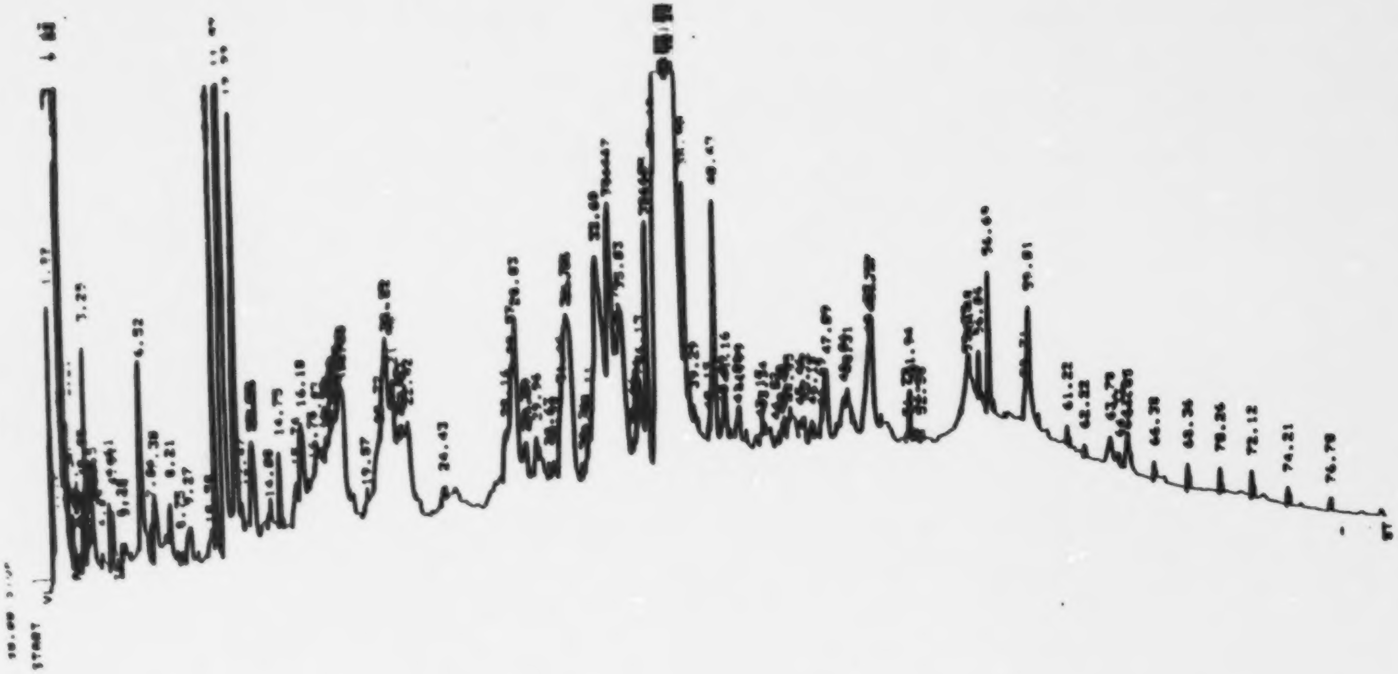


FIGURE IV D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID AN31-1-6.

V. MUD IDENTIFICATION: MILGEL® (Additive)

LAB NUMBER 83-325

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

V A. DRILLING MUD ELEMENTAL CONCENTRATIONS
MILGEL® ADDITIVE (Sample I.D.: 83-325)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation
Al	8.86(%)	2741.	0.020
Ba	0.064(%)	30.9	2.60
Cd	0.494	0.095	0.007
Ca	0.470(%)	—	—
Cr	8.02	0.689	0.287
Cu	8.18	1.17	0.002
Fe	3.75(%)	1992.	0.081
Pb	27.1	1.54	0.003
Sr	60.5	—	—
Zn	66.5	11.2	0.054
H_2O	–		

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

V B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

V B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10.100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

V B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (µg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

V B(cont). MILGEL● ADDITIVE WHOLE SAMPLE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Methylethylbenzene	959	66.5
Trimethylbenzene	990	52.1
Naphthalene	1178	14.0
2-Methylnaphthalene	1289	29.8
1-Methylnaphthalene	1305	16.1
*Dimethylnaphthalene	1399	18.1
*Dimethylnaphthalene	1414	17.8

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

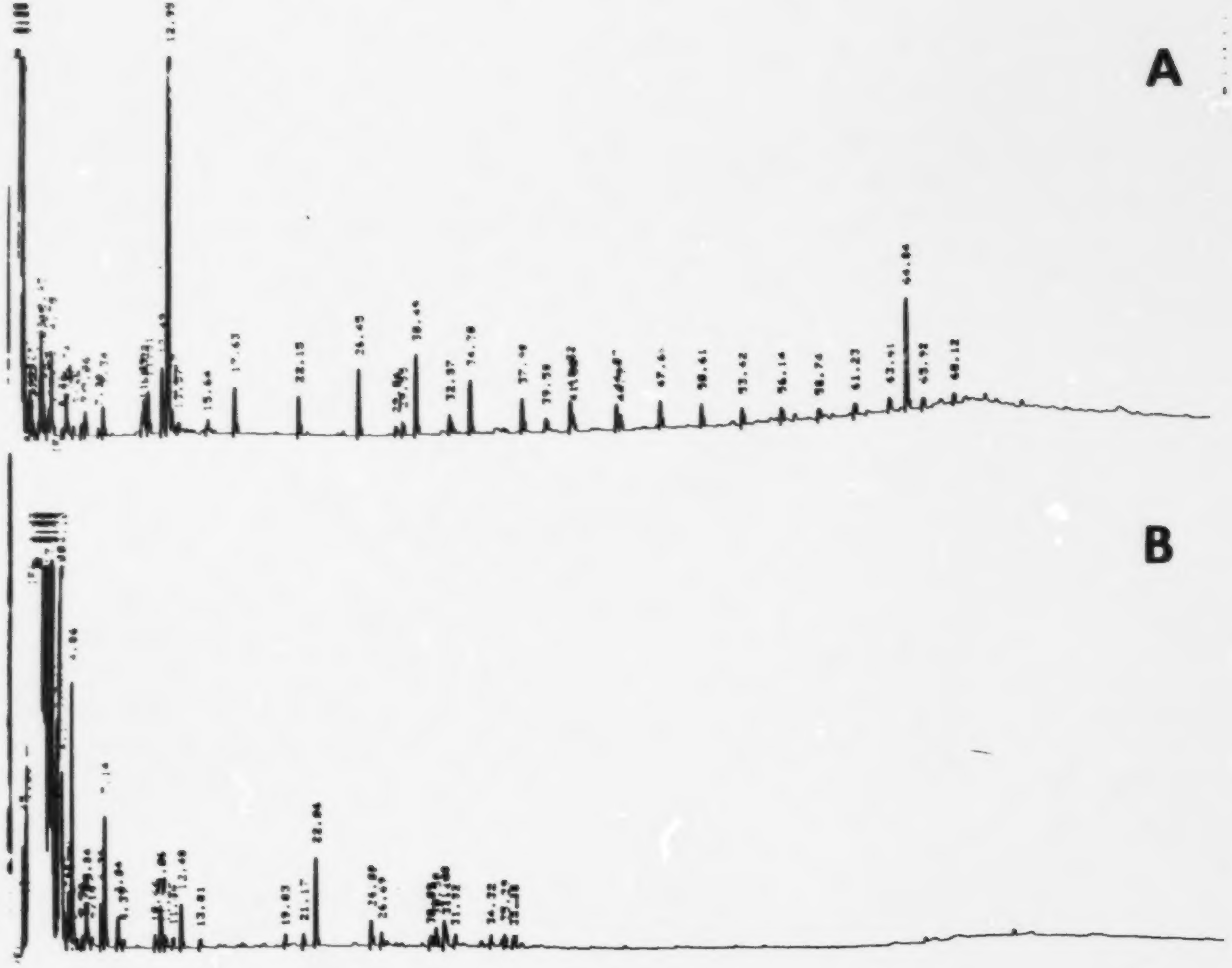


FIGURE V B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF BULK MILGEL®.

V.C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

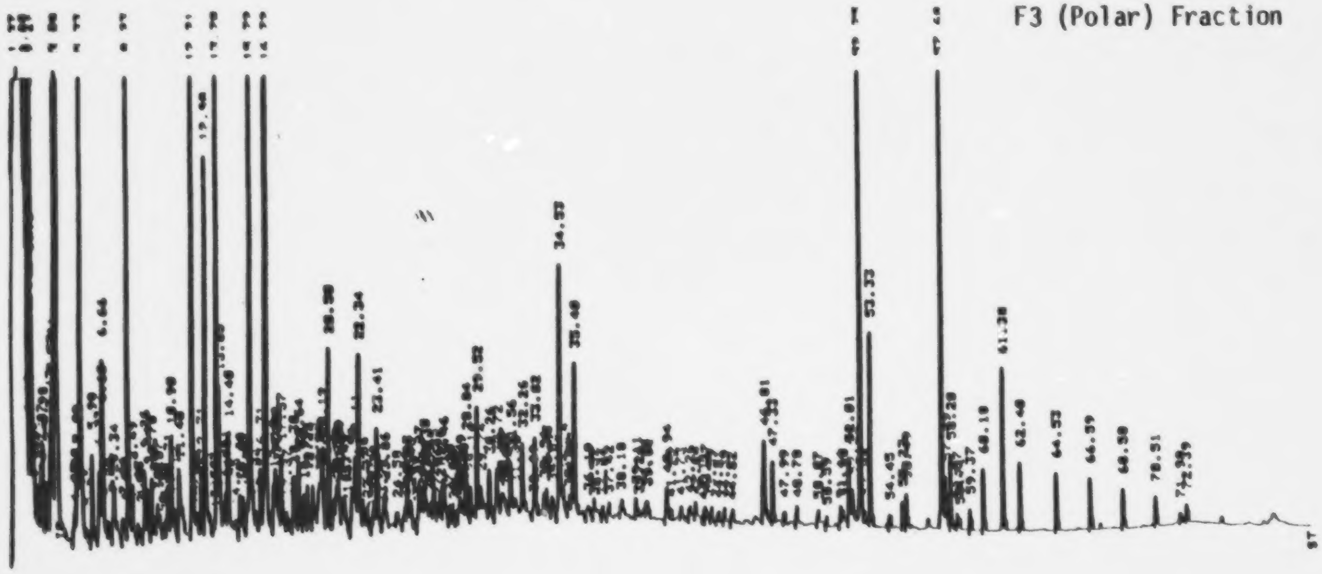


FIGURE V C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MILGEL®.

V C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTI

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

V C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

V C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	___	0.11	___	0.15	___	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

V C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

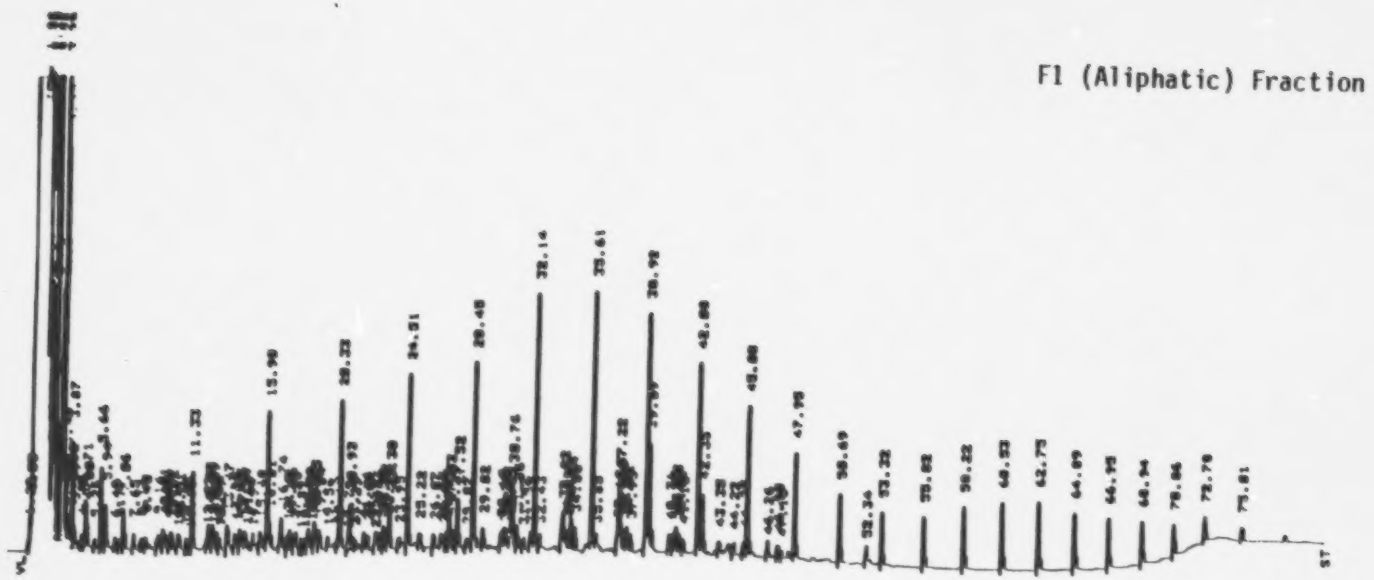


FIGURE V C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MILGEL®.

VC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

V C. MILGEL® ADDITIVE SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
Naphthalene	1178	0.30
2-Methylnaphthalene	1290	0.40
1-Methylnaphthalene	1307	0.21
*Dimethynaphthalene	1401	0.12
*Dimethynaphthalene	1416	0.34

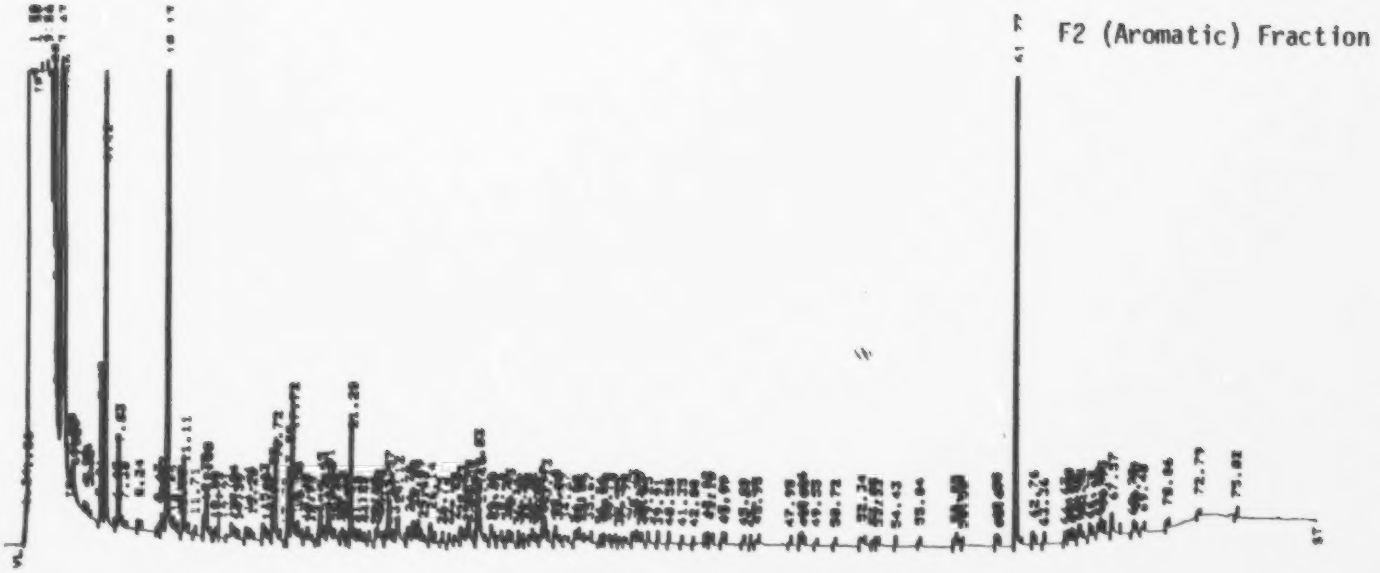


FIGURE V C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID MILGEL®.

V D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Compone (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

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*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

V D (cont.) MILGEL® ADDITIVE SAMPLE - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l
C_7-Alcohol	909	.3
C_8-Alcohol	1022	7.6
Ethylhexanol	1034	.4
C_9-Ketone	1065	.1
Benzoic Acid	1219	4.4
Methoxybenzaldehyde	1413	1.7
Molecular Ion m/e = 170	1556	.1
Methoxybenzoic Acid	1600	.3
Molecular Ion m/e = 199	1674	.1
C_{18}-Carboxylic Acid	2159	.5
C_{20}-Carboxylic Acid	2443	.2

[a] Concentrations expressed per unit volume of wet sample.

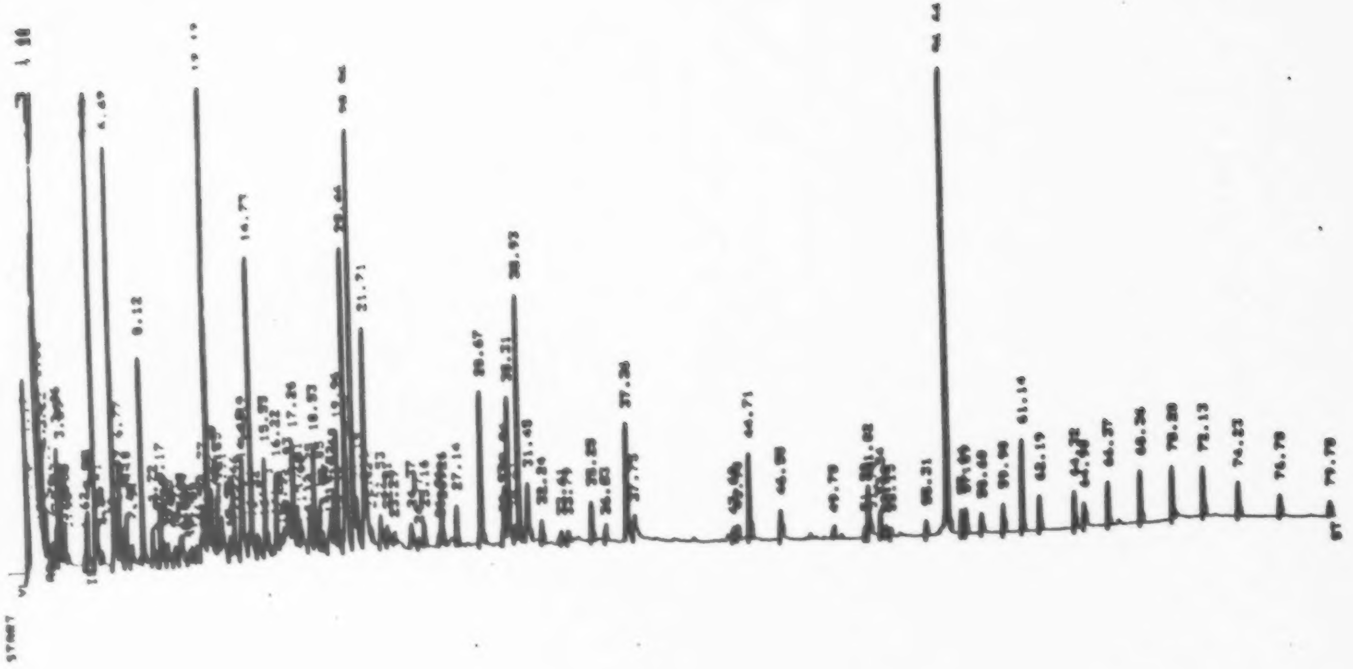

FIGURE V D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF MILGEL® ADDITIVE.

VI. MUD IDENTIFICATION: SV 76-2-5

LAB NUMBER 83-326

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

VI A. DRILLING MUD ELEMENTAL CONCENTRATIONS

SV 76-2-5 (Sample I.D.: 83-326)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	0.61(%)	482.	0.030
Ba	37.5(%)	12.5	0.407
Cd	1.62	0.315	0.009
Ca	0.82(%)	—	—
Cr	1345.	457.	43.6
Cu	86.1	15.0	1.27
Fe	3.63(%)	1975.	1.85
Pb	151.	18.4	0.161
Sr	536.	—	—
Zn	495.	93.1	0.487
H_2O	58.1(%)	—	—

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

VI B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

VI B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

VI B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

VI B (cont). SV76-2-5 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/1)[a]
Methylethylbenzene	952	129
*Trimethylbenzene	986	730
*Trimethylbenzene	1015	288
Methylpropylbenzene	1045	218
*Dimethylethylbenzene	1052	184
*Dimethylethylbenzene	1078	401
Methyl-(methylethyl)-benzene	1098	257
Dimethylpropylbenzene	1109	467
*Tetramethylbenzene	1113	551
Methylpropenylbenzene	1141	522
*Tetramethylbenzene	1144	150
Naphthalene	1178	1290
2-Methylnaphthalene	1291	9430
1-Methylnaphthalene	1307	5020
1,1'-Biphenyl	1391	3120
*Dimethylnaphthalene	1402	8950
*Dimethylnaphthalene	1418	6320
*Dimethylnaphthalene	1437	2740
*Dimethylnaphthalene	1452	2620
Methyl-1,1'-biphenyl	1484	1790
Methylethylnaphthalene	1503	2830
*Trimethylnaphthalene	1525	2660
*Trimethylnaphthalene	1530	4280
*Trimethylnaphthalene	1546	1500
*Trimethylnaphthalene	1580	1020
*Methyl-(methylethyl)-Naphthalene	1649	1290
*Methyl-(methylethyl)-Naphthalene	1671	1720
Phenanthrene	1779	2590
Methyldibenzothiophene	1853	1280
*Methylphenanthrene	1895	1900
*Methylphenanthrene	1920	1650
*Dimethylphenanthrene	2017	918
*Dimethylphenanthrene	2036	1860
*Dimethylphenanthrene	2042	598

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

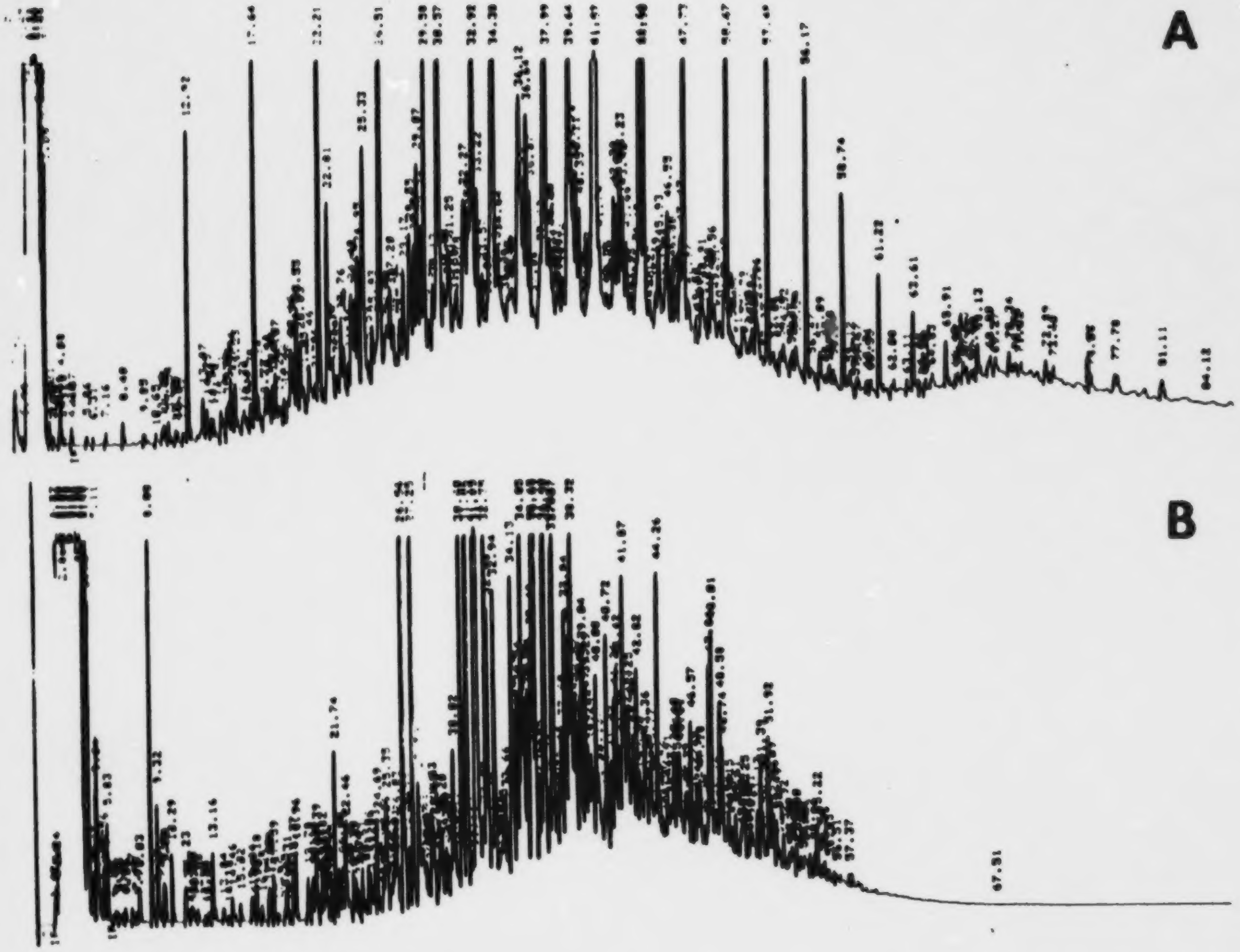

FIGURE VI B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID SV76-2-5.

VI C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

VI C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	___	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	___	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	___	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	___	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	___	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	___	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

VI C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.90	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

VI C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

F1 (Aliphatic) Fraction

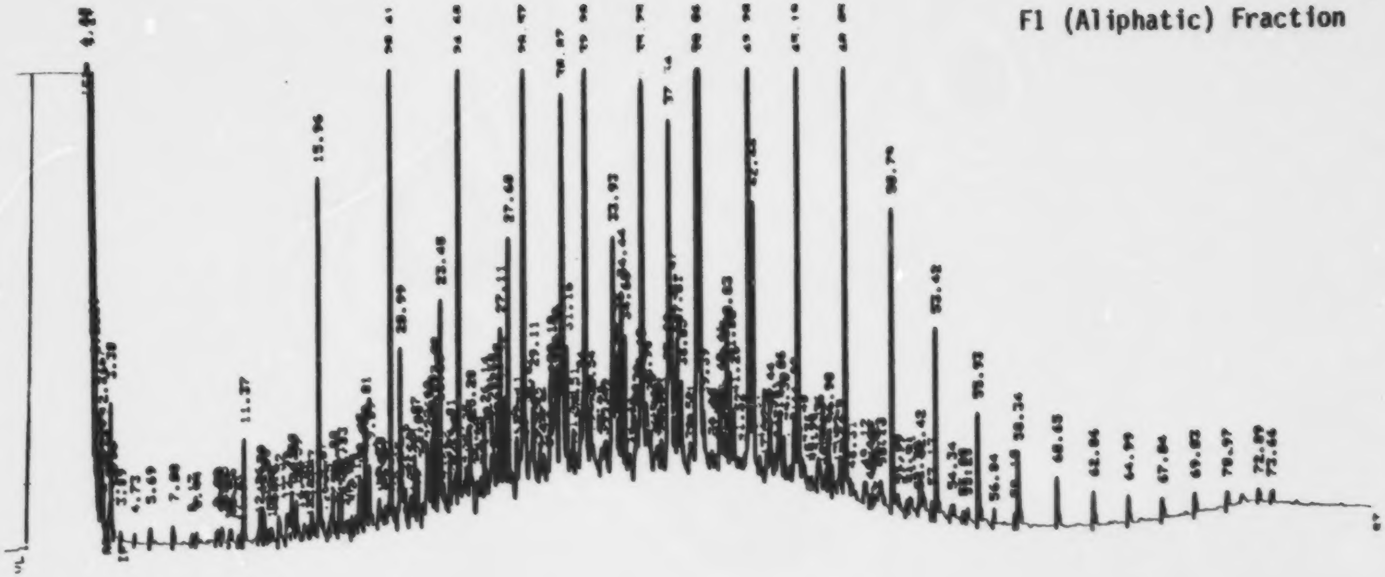

FIGURE VI C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID SV76-2-5.

VI C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

VI C. SV76-2-5 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
Methylpropylbenzene	1045	1.56
*Tetramethylbenzene	1113	0.74
*Tetrymethylbenzene	1146	0.95
Naphthalene	1179	8.82
2-Methylnaphthalene	1291	44.4
1-Methynaphthalene	1307	29.9
1,1'Biphenyl	1390	10.1
*Dimethylnaphthalene	1402	34.0
*Dimethylnaphthalene	1417	24.6
*Dimethylnaphthalene	1436	10.3
*Dimethylnaphthalene	1452	9.2
Methyl-1,1'-biphenyl	1485	7.6
Methylethylnaphthalene	1502	7.6
*Trimethylnaphthalene	1524	8.2
*Trimethylnaphthalene	1529	11.7
*Trimethylnaphthalene	1545	5.7
*Methyl-(methylethyl)-Naphthalene	1648	2.6
*Methyl-(methylethyl)-Naphthalene	1669	3.6
*Methylphenanthrene	1897	3.5
*Methylphenanthrene	1921	1.2
*Dimethylphenanthrene	2038	0.64
*Dimethylphenanthrene	2044	0.30

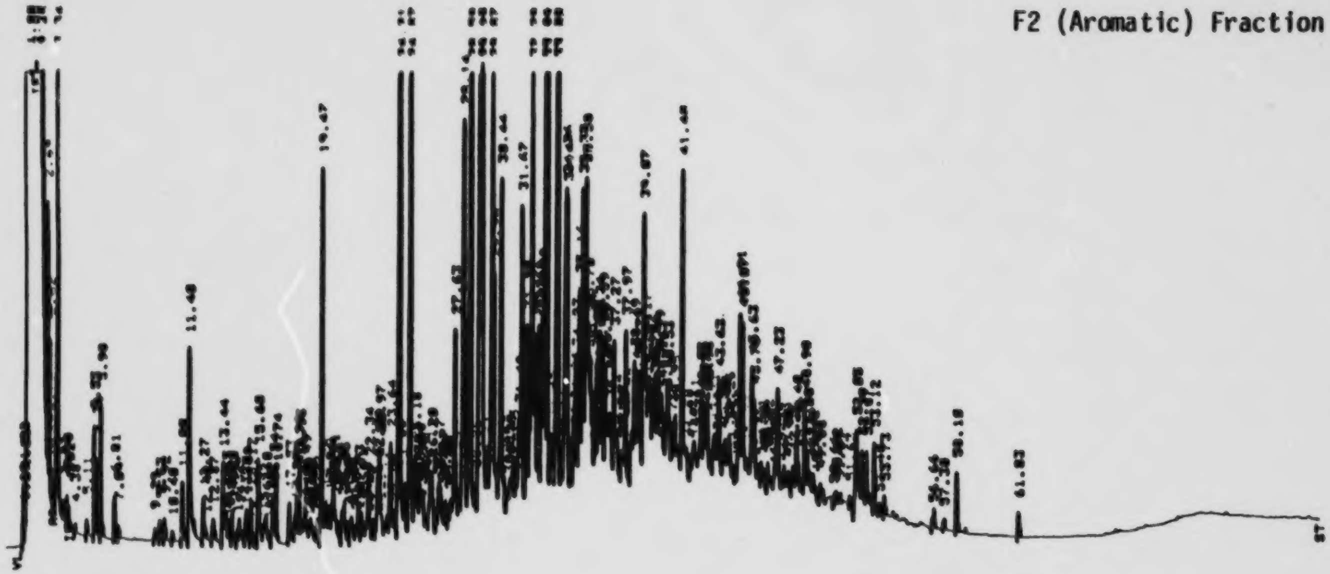
F2 (Aromatic) Fraction

FIGURE VI C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID SV76-2-5.

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VI C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (µg/l)	Unresolved (µg/l)	Total (µg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

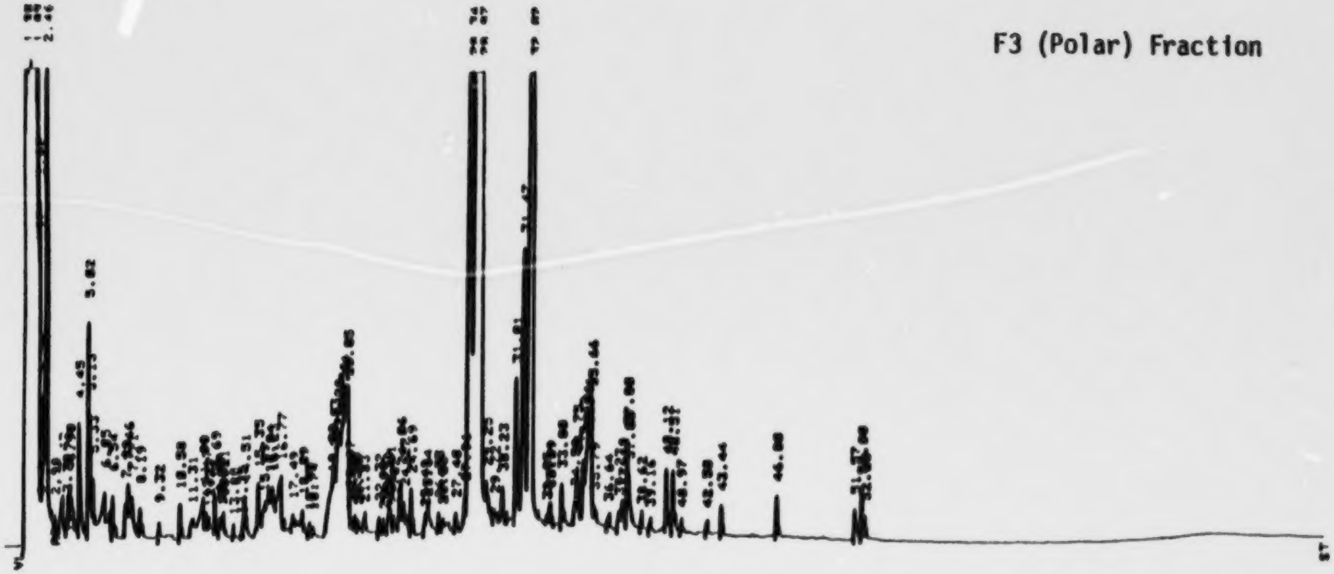

FIGURE VI C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID SV76-2-5.

VI D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

VI D (cont.) SV76-2-5 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (µg/l)[a]
C_7-Alcohol	912	39.5
C_8-Alcohol	1021	33.9
Ethylhexanol	1033	5.9
C_9-Ketone	1065	20.4
Benzoic Acid	1225	13.8
Methoxybenzaldehyde	1411	24.8
C_{13}-Ketone	1496	17.5
Molecular Ion m/e = 170	1560	35.0
Methoxybenzoic Acid	1593	59.7
Molecular Ion m/e = 199	1676	28.3
Hexadecanoic Acid	1975	1.0
C_{18}-Alcohol	2066	1.8
C_{18}-Carboxylic Acid	2161	6.3
C_{20}-Carboxylic Acid	2442	10.3

[a] Concentrations expressed per unit volume of wet sample.

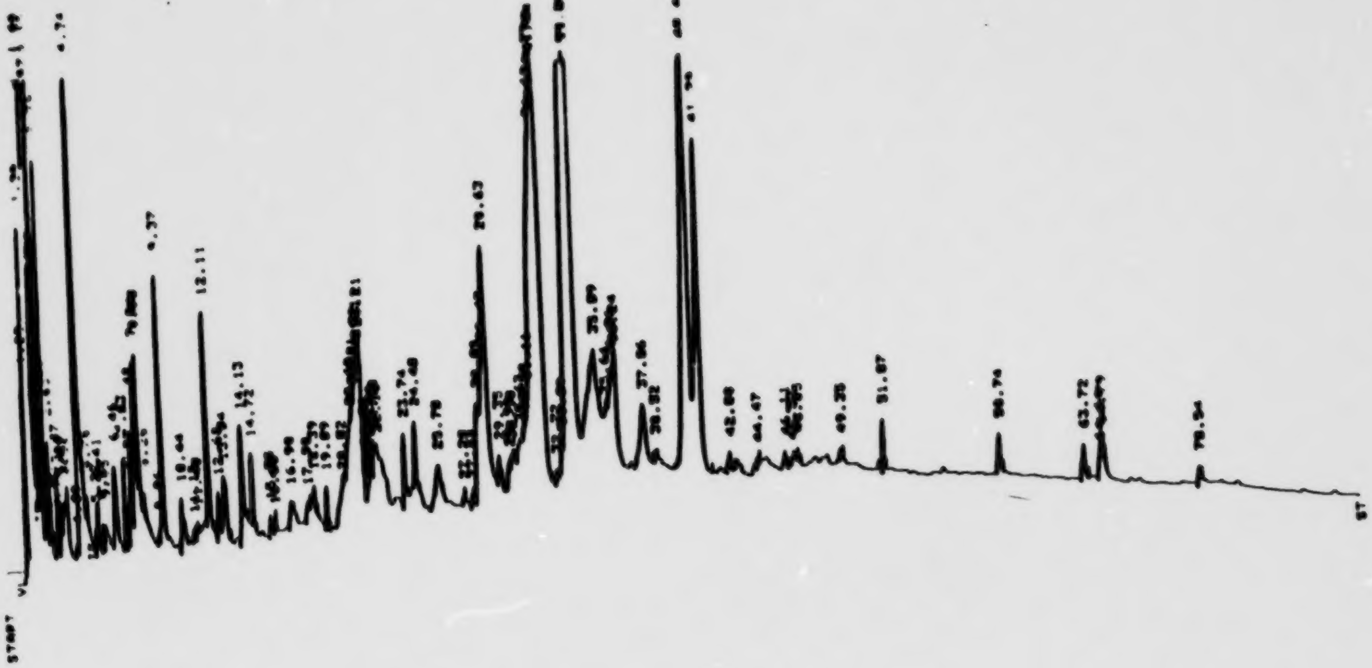

FIGURE VI D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID SV76-2-5.

VII. MUD IDENTIFICATION: P1-1-3

LAB NUMBER: 83-2000

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

VII A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P1-1-3 (Sample I.D.: 83-2000)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation
Al	1.01(%)	555.	0.047
Ba	36.9(%)	10.7	0.460
Cd	1.85	0.260	0.004
Ca	0.86(%)	—	—
Cr	814.	221.	3.34
Cu	62.3	15.9	0.119
Fe	3.44(%)	1566.	1.49
Pb	129.	13.3	0.093
Sr	303.	—	—
Zn	410.	52.5	0.075
H_2O	59.9 (%)	—	—

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[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

VII B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/l)	UCM (mg/l)	Resolved (mg/l)	UCM (mg/l)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

VII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	n-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

VII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

VII B. (cont.)P-1 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Methylethylbenzene	959	496
*Trimethylbenzene	990	2,280
*Trimethylbenzene	1017	2,170
*Methylpropylbenzene	1048	1,420
Dimethylethylbenzene	1056	1,570
*Methylpropylbenzene	1063	1,220
Methyl-(methylethyl)-benzene	1074	5,170
Dimethylethylbenzene	1082	3,600
Methyl-(methylethyl)-benzene	1101	4,030
Dimethylpropylbenzene	1110	1,510
*Tetramethylbenzene	1112	2,840
Methylpropenylbenzene	1139	5,480
*Tetramethylbenzene	1143	1,710
Dimethylpropylbenzene	1158	1,920
Naphthalene	1173	5,290
2-Methylnaphthalene	1285	34,700
1-Methylnaphthalene	1301	18,100
1,1'-Biphenyl	1372	6,120
*Dimethylnaphthalene	1396	35,600
*Dimethylnaphthalene	1411	15,200
*Dimethylnaphthalene	1429	7,580
*Dimethylnaphthalene	1444	8,500
Methyl-1,1'-biphenyl	1479	17,800
Methylethylnaphthalene	1496	14,600
*Trimethylnaphthalene	1518	9,710
*Trimethylnaphthalene	1522	16,700
*Trimethylnaphthalene	1538	3,910
*Trimethylnaphthalene	1555	28,700
*Trimethylnaphthalene	1571	7,870
*Methyl-(methylethyl)-Naphthalene	1641	5,760
*Methyl-(methylethyl)-Naphthalene	1662	7,840
Phenanthrene	1766	6,350
Methyldibenzothiophene	1840	4,700
*Methylphenanthrene	1883	6,130
*Methylphenanthrene	1888	4,900
*Methylphenanthrene	1907	4,320
*Dimethylphenanthrene	2003	2,570
*Dimethylphenanthrene	2022	8,160
*Dimethylphenanthrene	2028	1,180

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

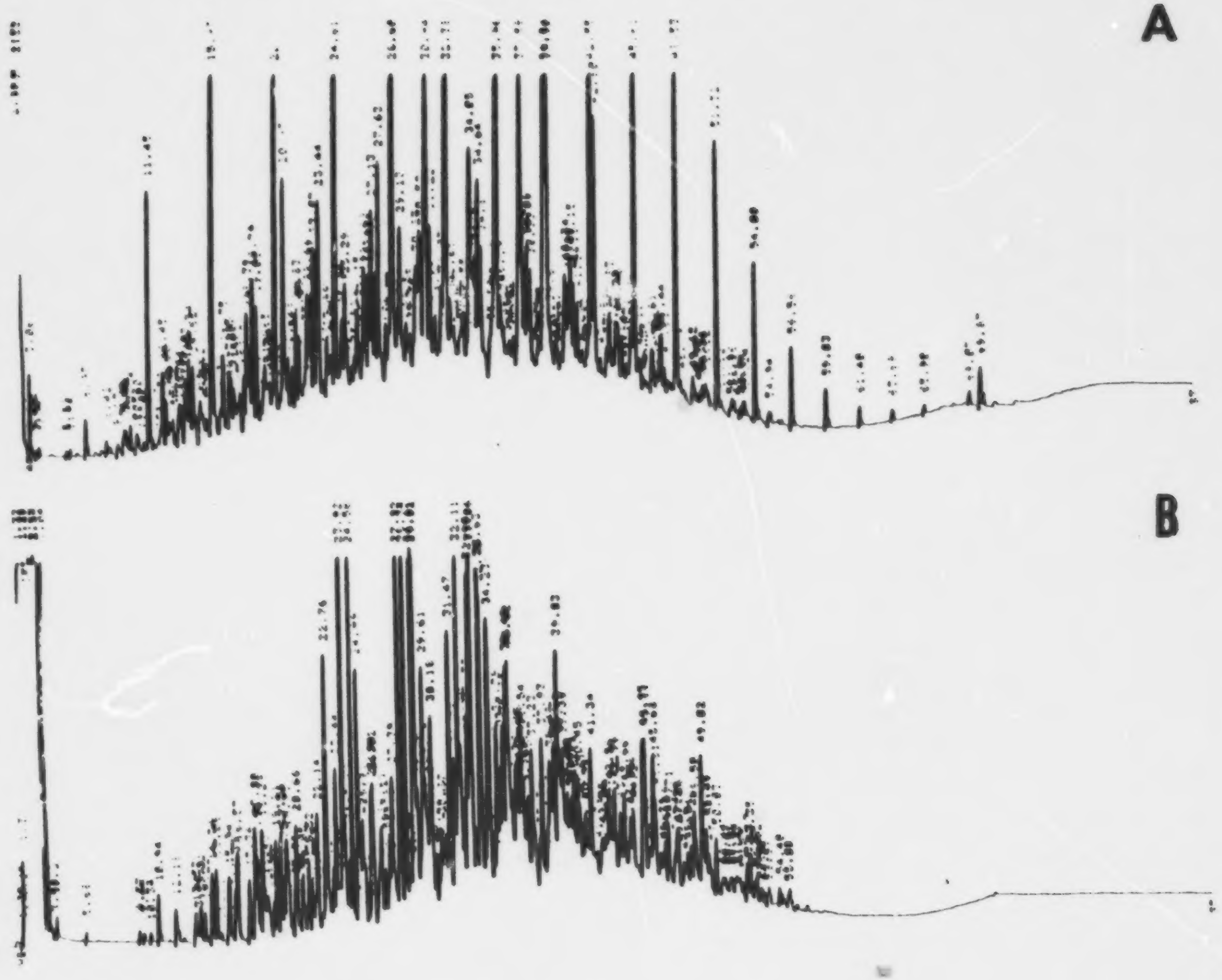


FIGURE VII B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-1.

VII C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

VII C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	$N\text{-}C_9$	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

VII C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

VII C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

83 - 2000 F1

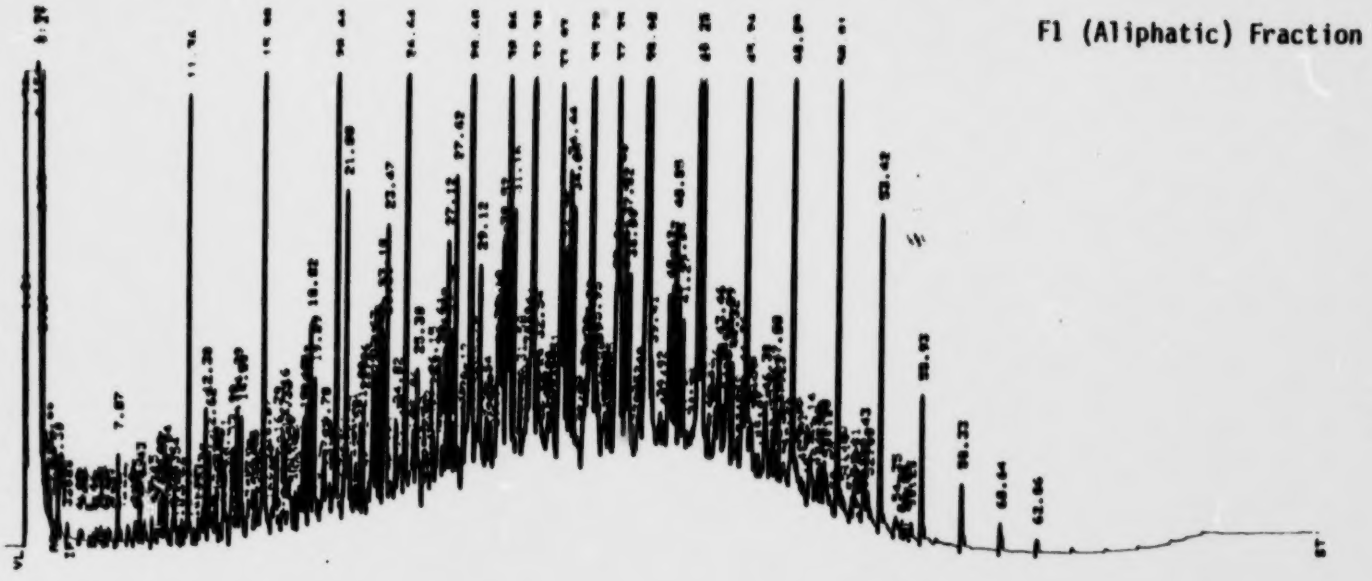


FIGURE VII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-1.

VII C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

VII C. P-1 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (µg/l)
Methylethylbenzene	959	10.9
*Trimethylbenzene	992	23.6
*Methylpropylbenzene	1050	4.8
Dimethylethylbenzene	1058	11.1
*Methylpropylbenzene	1065	7.9
Methyl-(methyethyl)-benzene	1076	2.4
Dimethylethylbenzene	1083	23.1
Methyl-(methyethyl)-benzene	1100	7.9
*Tetramethylbenzene	1114	11.0
*Tetramethylbenzene	1144	3.1
Dimethylpropylbenzene	1158	28.0
Naphthalene	1174	4.4
2-Methylnaphthalene	1291	25.3
1-Methylnaphthalene	1300	29.4
1,1'-biphenyl	1372	8.5
*Dimethylnaphthalene	1410	7.6
*Dimethylnaphthalene	1445	2.1
Methyl-1,1'-biphenyl	1481	3.7
Methylethylnaphthalene	1494	26.8
*Trimethylnaphthalene	1519	29.5
*Trimethylnaphthalene	1524	32.0
*Trimethylnaphthalene	1554	6.4
*Trimethylnaphthalene	1570	6.6
*Methyl-(methylethyl)-naphthalene	1664	1.8
Methyldibenzothiophene	1839	12.8
*Methylphenanthene	1883	2.4

VII C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

83 - 2000 F3

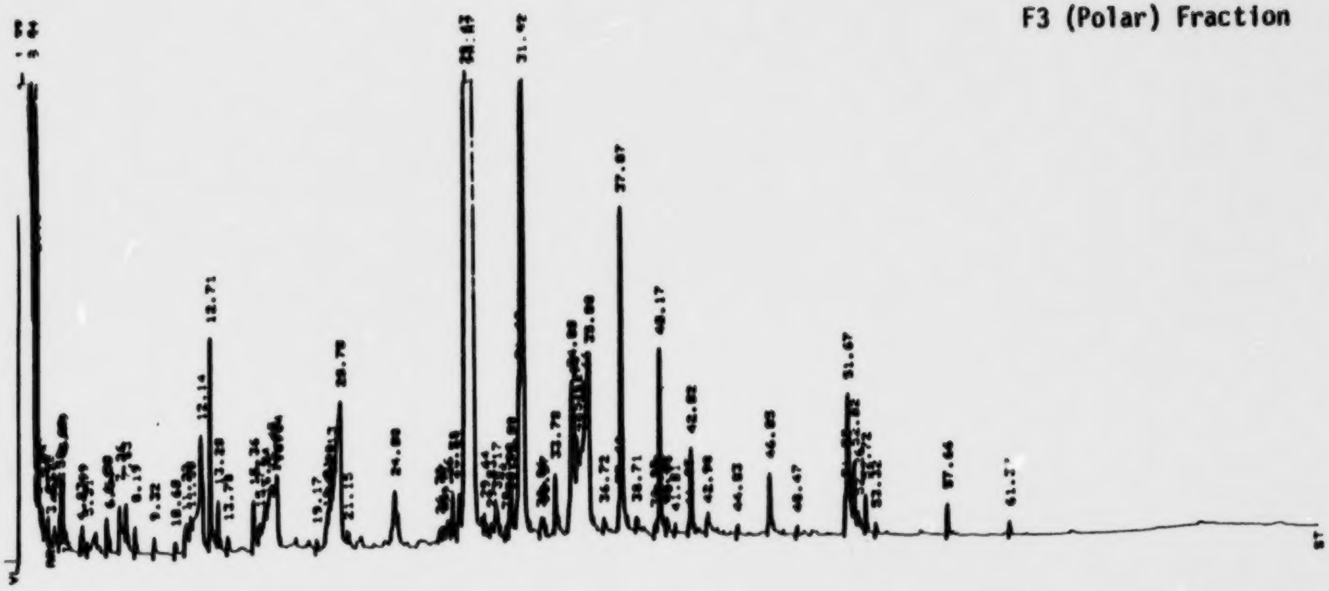


FIGURE VII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-1.

83 - 2000 F2

F2 (Aromatic) Fraction

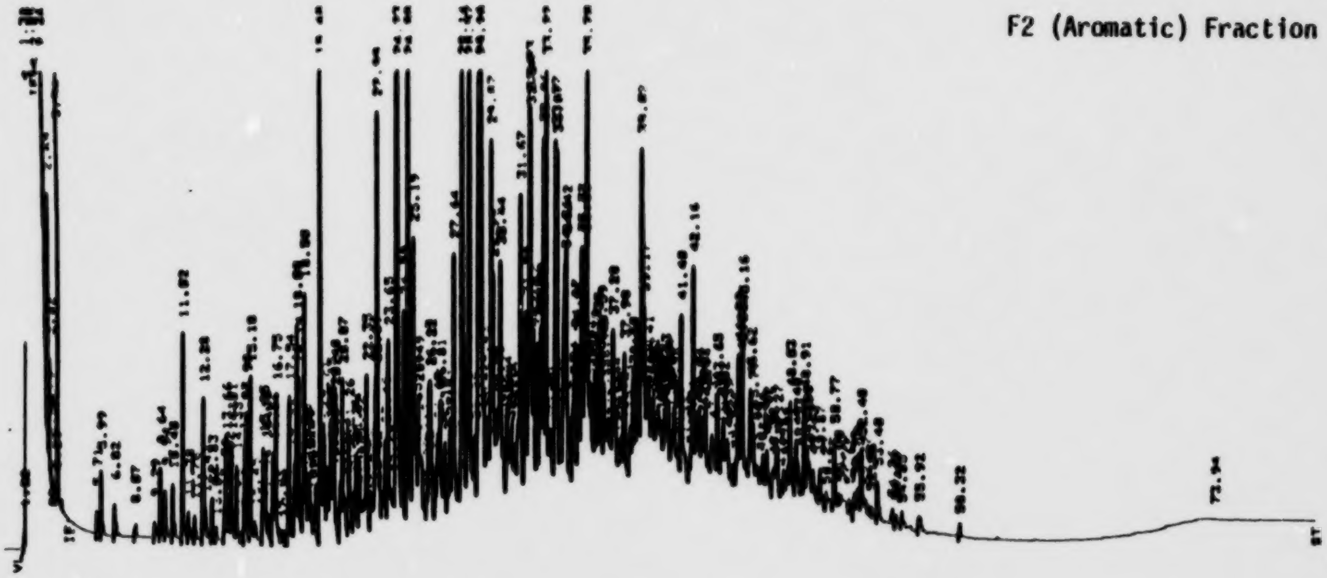


FIGURE VII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-1.

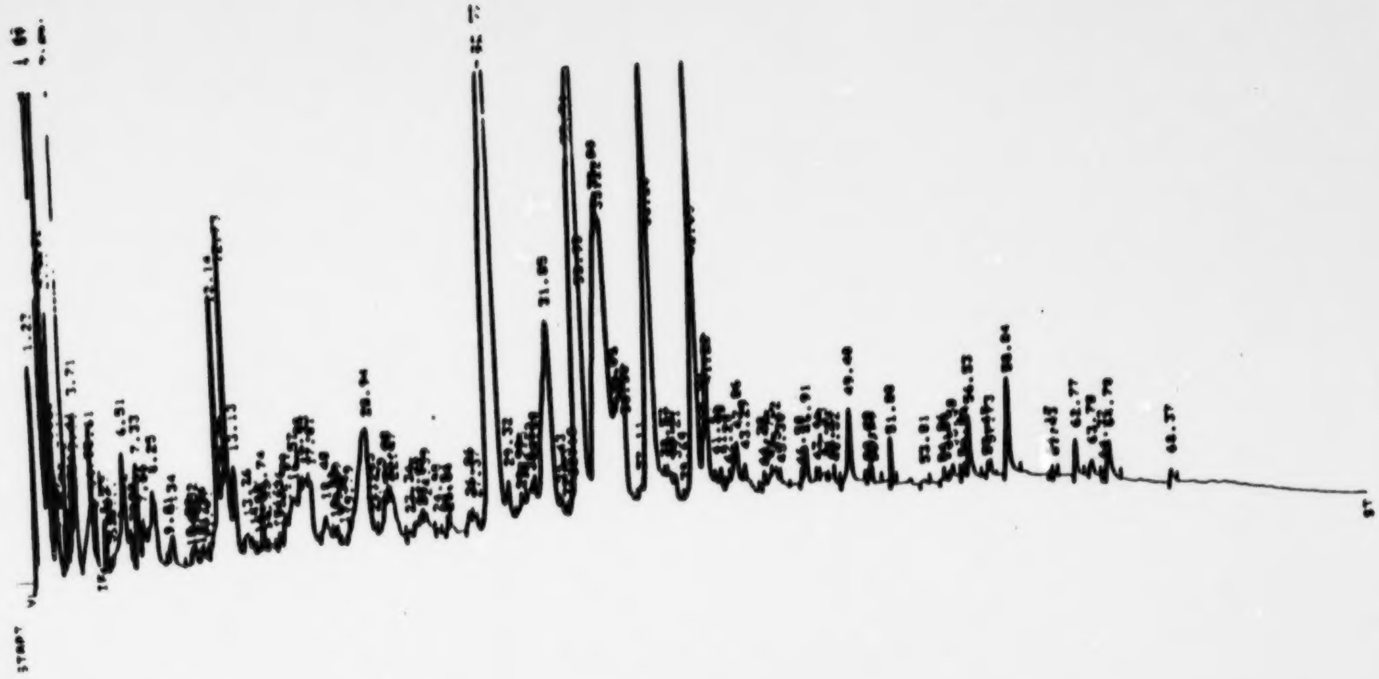


FIGURE VII D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-1.

VII D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

VII D (cont.). P-1 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
C_7-Alcohol	911	25.6
Ethylhexanol	1034	43.6
Benzoic Acid	1219	97.2
Methoxybenzaldehyde	1415	14.1
C_{13}-Ketone	1500	167.
Molecular Ion m/e = 170	1559	148.
Methoxybenzoic Acid	1590	99.0
Molecular Ion m/e = 199	1682	287.
Hexadecanoic Acid	1977	12.2
C_{18}-Alcohol	2071	35.6
C_{18}-Carboxylic Acid	2162	6.9
C_{19}-Carboxylic Acid	2305	7.1
C_{20}-Carboxylic Acid	2447	52.0

[a] Concentrations expressed per unit volume of wet sample.

VIII. MUD IDENTIFICATION: P2-1-3

LAB NUMBER : 83-2001

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

VIII A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P2-1-3 (Sample I.D.: 83-2001)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation
Al	0.76(%)	793.	0.009
Ba	37.2(%)	8.05	3.32
Cd	11.8	2.38	0.007
Ca	0.65(%)	—	—
Cr	483.	237.	0.896
Cu	39.7	11.8	0.019
Fe	0.70(%)	1784.	1.27
Pb	291.	40.6	0.046
Sr	226.	—	—
Zn	2064.	338.	0.007
H_2O	58.8(%)	—	—

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

VIII B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

VIII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

VIII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

VIII B(cont). P-2 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Methylethylbenzene	959	122.
*Trimethylbenzene	989	269.
*Trimethylbenzene	1017	231.
*Methylpropylbenzene	1047	149.
Dimethylethylbenzene	1055	118.
*Methylpropylbenzene	1062	80.1
Methyl-(methylethyl)-benzene	1074	295.
Dimethylethylbenzene	1081	247.
Methyl-(methylethyl)-benzene	1100	126.
Dimethylpropylbenzene	1110	101.
*Tetramethylbenzene	1115	148.
Methylpropenylbenzene	1142	334.
*Tetramethylbenzene	1146	136.
Dimethylpropylbenzene	1161	216.
Naphthalene	1175	528.
2-Methylnaphthalene	1286	2370.
1-Methylnaphthalene	1302	1670.
1,1'-Biphenyl	1373	232.
*Dimethylnaphthalene	1397	2920.
*Dimethylnaphthalene	1413	641.
*Dimethylnaphthalene	1431	615.
*Dimethylnaphthalene	1446	759.
Methyl-1,1'-biphenyl	1480	1200.
Methylethylnaphthalene	1497	1010.
*Trimethylnaphthalene	1520	637.
*Trimethylnaphthalene	1524	1200.
*Trimethylnaphthalene	1540	86.5
*Trimethylnaphthalene	1557	3090.
*Trimethylnaphthalene	1573	389.
*Methyl-(methylethyl)-Naphthalene	1643	434.
*Methyl-(methylethyl)-Naphthalene	1664	574.
Phenanthrene	1768	600.
Methyldibenzothiophene	1841	232.
*Methylphenanthrene	1884	397.
*Methylphenanthrene	1889	206.
*Methylphenanthrene	1908	262.
*Dimethylphenanthrene	2005	132.
*Dimethylphenanthrene	2024	295.
*Dimethylphenanthrene	2030	46.8

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

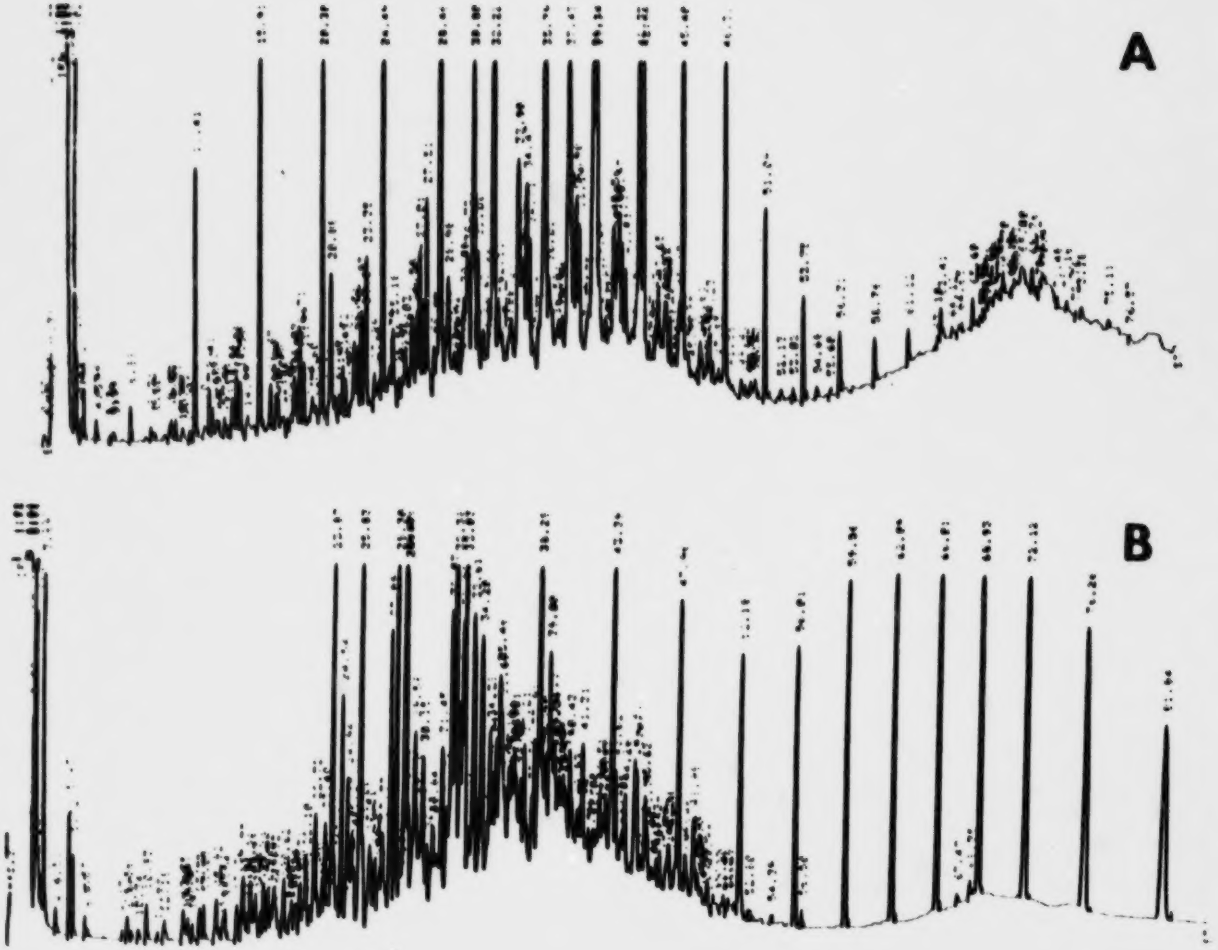


FIGURE VIII B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-2.

VIIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

VIIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/1)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

VIIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

VIIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC$_{23}$	NC$_{24}$	NC$_{25}$	NC$_{26}$	NC$_{27}$	NC$_{28}$	NC$_{29}$	NC$_{30}$	NC$_{31}$	NC$_{32}$
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

83 2001 - F1

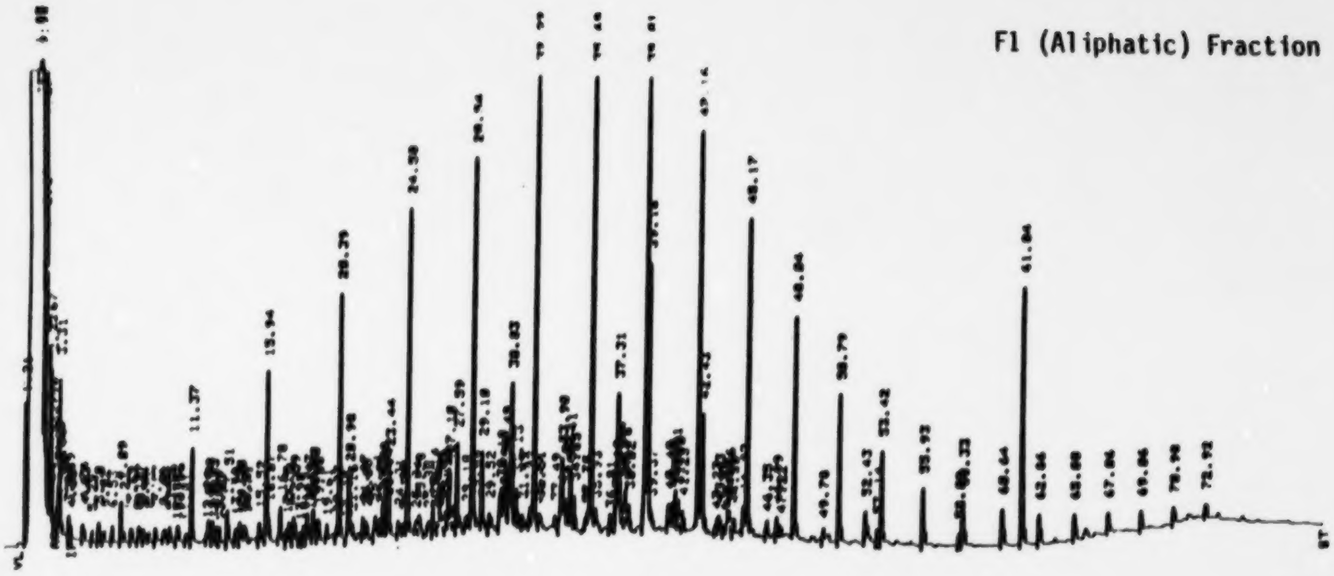


FIGURE VIII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-2.

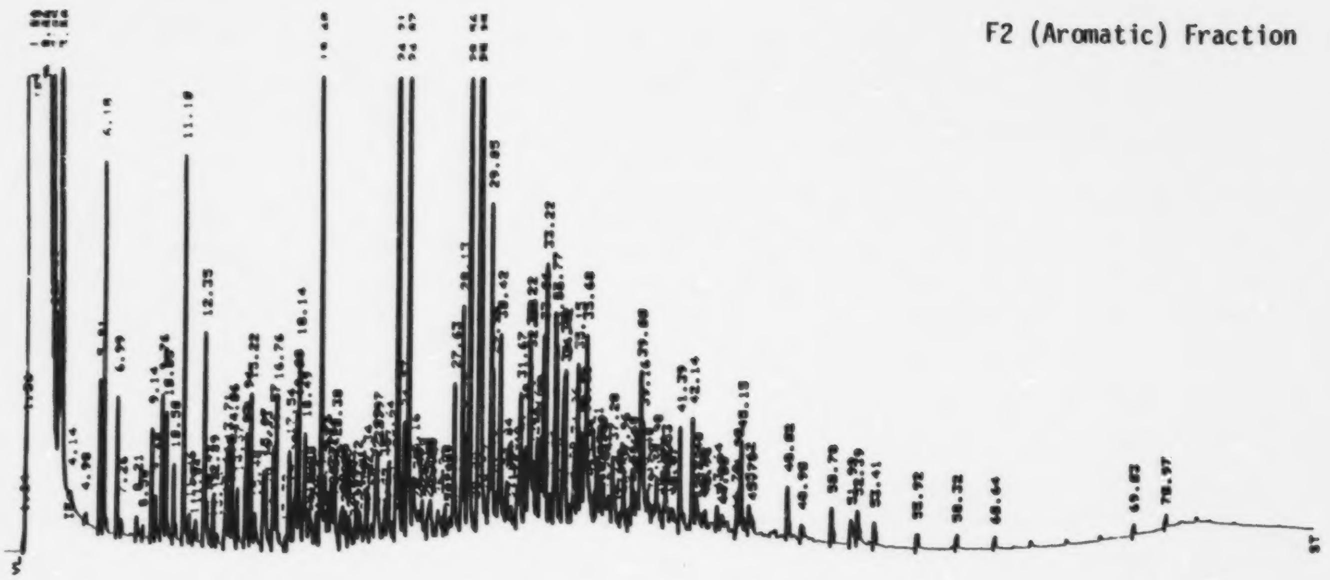
VIIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

VIII C. P-2 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
Dimethylethylbenzene	1055	0.81
Methyl-(methylethyl-benzene	1100	0.89
*Tetramethylbenzene	1114	1.8
Methylpropenylbenzene	1142	0.33
*Tetramethylbenzene	1146	1.87
Naphthalene	1175	0.72
2-Methylnaphthalene	1291	33.8
1-Methylnaphthalene	1300	2.5
1,1'-Biphenyl	1377	3.4
*Dimethylnaphthalene	1444	0.37
Methyl-1,1'-biphenyl	1480	0.34
Methylethylnaphthalene	1500	0.61
*Trimethylnaphthalene	1519	1.43
*Trimethylnaphthalene	1524	2.8
*Methylphenanthene	1891	0.73
*Dimethylphenanthene	2032	0.31

83 - 2002   F2



F2 (Aromatic) Fraction

FIGURE VIII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-2.

VIIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

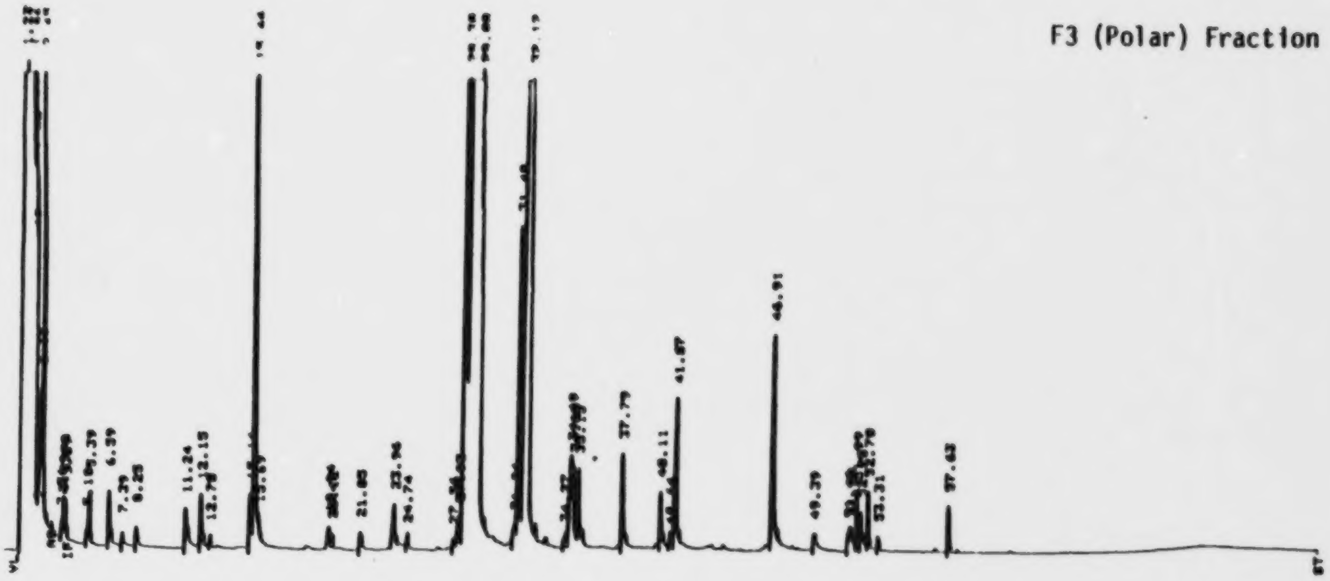


FIGURE VIII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-2.

VIIID. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

VIII D (cont.). P-2 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
C_7-Alcohol	909	<0.1
C_8-Alcohol	1022	0.1
Ethylhexanol	1034	<0.1
Benzoic Acid	1218	<0.1
Methoxybenzaldehyde	1423	.8
Molecular Ion m/e = 170	1566	1.0
Methoxybenzoic Acid	1600	.2
Molecular Ion m/e = 199	1687	.5
Hexadecanoic Acid	1977	<0.1
C_{18}-Alcohol	2070	<0.1
C_{18}-Carboxylic Acid	2162	<0.1
C_{20}-Carboxylic Acid	2440	<0.1

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[a] Concentrations expressed per unit volume of wet sample.

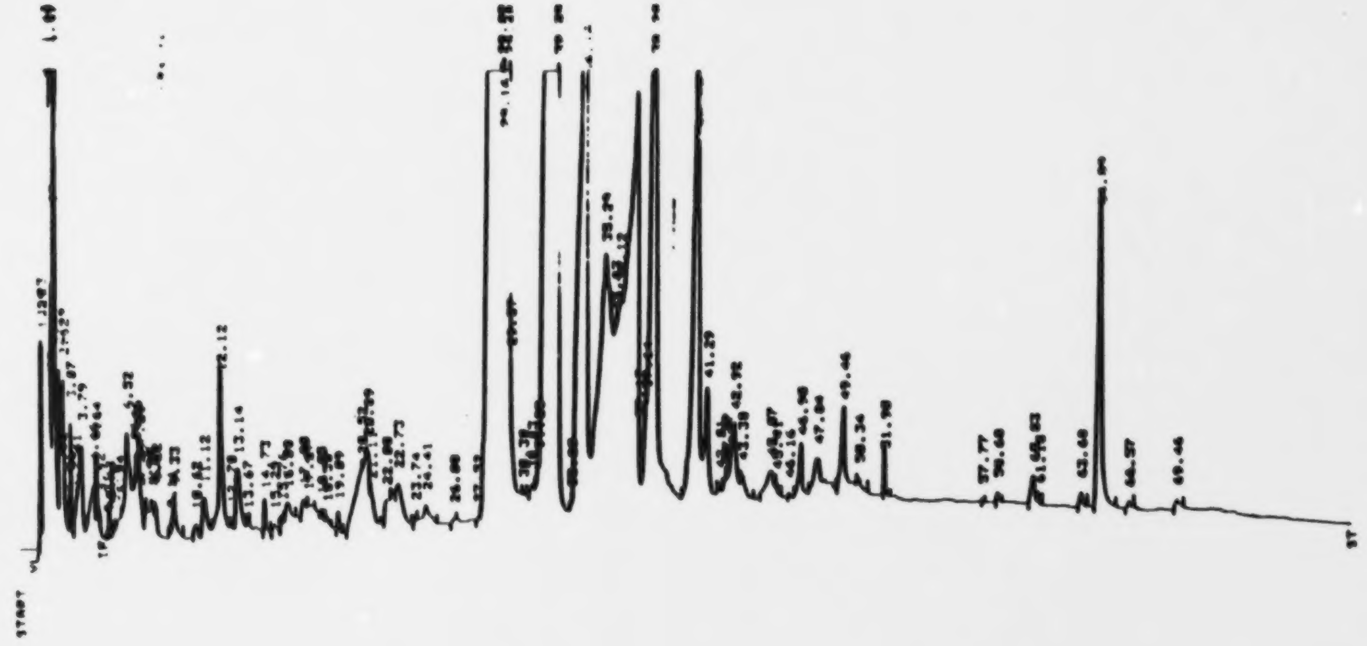


FIGURE VIII D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED "PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-2.

IX. MUD IDENTIFICATION: P3-1-3

LAB NUMBER: 83-2002

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

IX A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P3-1-3 (Sample I.D.: 83-2002)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	1.30(%)	661.	0.132
Ba	35.1(%)	22.9	0.813
Cd	2.10	0.053	0.002
Ca	0.74(%)	—	—
Cr	459.	138.	2.60
Cu	90.4	11.1	0.243
Fe	5.67(%)	1810.	1.84
Pb	100.	10.2	0.104
Sr	383.	—	—
Zn	439.	41.8	0.140
H_2O	57.8 (%)	—	—

[a] Concentrations expressed as µg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as µg/g wet weight unless otherwise indicated.

IX B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/l)	UCM (mg/l)	Resolved (mg/l)	UCM (mg/l)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

IX B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	36
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

IX B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

IX B. (cont.) P-3 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Trimethylbenzene	990	443
Methylpropylbenzene	1048	226
Dimethylethylbenzene	1055	316
*Methyl-(methylethyl)-benzene	1074	708
Dimethylethylbenzene	1081	540
*Methyl-(methylethyl)-benzene	1101	910
Dimethylpropylbenzene	1111	313
*Tetramethylbenzene	1115	427
Methylpropenylbenzene	1142	1,170
*Tetramethylbenzene	1146	263
Dimethylpropylbenzene	1161	454
Naphthalene	1174	1,360
2-Methylnaphthalene	1285	12,600
1-Methylnaphthalene	1301	7,550
1,1'-Biphenyl	1371	1,260
*Dimethylnaphthalene	1396	15,300
*Dimethylnaphthalene	1411	6,550
*Dimethylnaphthalene	1429	2,930
*Dimethylnaphthalene	1444	3,760
Methyl-1,1'-biphenyl	1479	5,270
Methylethylnaphthalene	1495	5,780
*Trimethylnaphthalene	1517	3,730
*Trimethylnaphthalene	1522	6,130
*Trimethylnaphthalene	1538	857
*Trimethylnaphthalene	1554	11,100
*Trimethylnaphthalene	1571	2,570
*Methyl-(methylethyl)-Naphthalene	1641	4,390
*Methyl-(methylethyl)-Naphthalene	1662	2,460
Phenanthrene	1766	4,170
Methyldibenzothiophene	1841	2,160
*Methylphenanthrene	1883	3,490
*Methylphenanthrene	1887	2,690
*Methylphenanthrene	1906	1,990
*Dimethylphenanthrene	2003	3,310
*Dimethylphenanthrene	2021	3,400
*Dimethylphenanthrene	2028	814

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

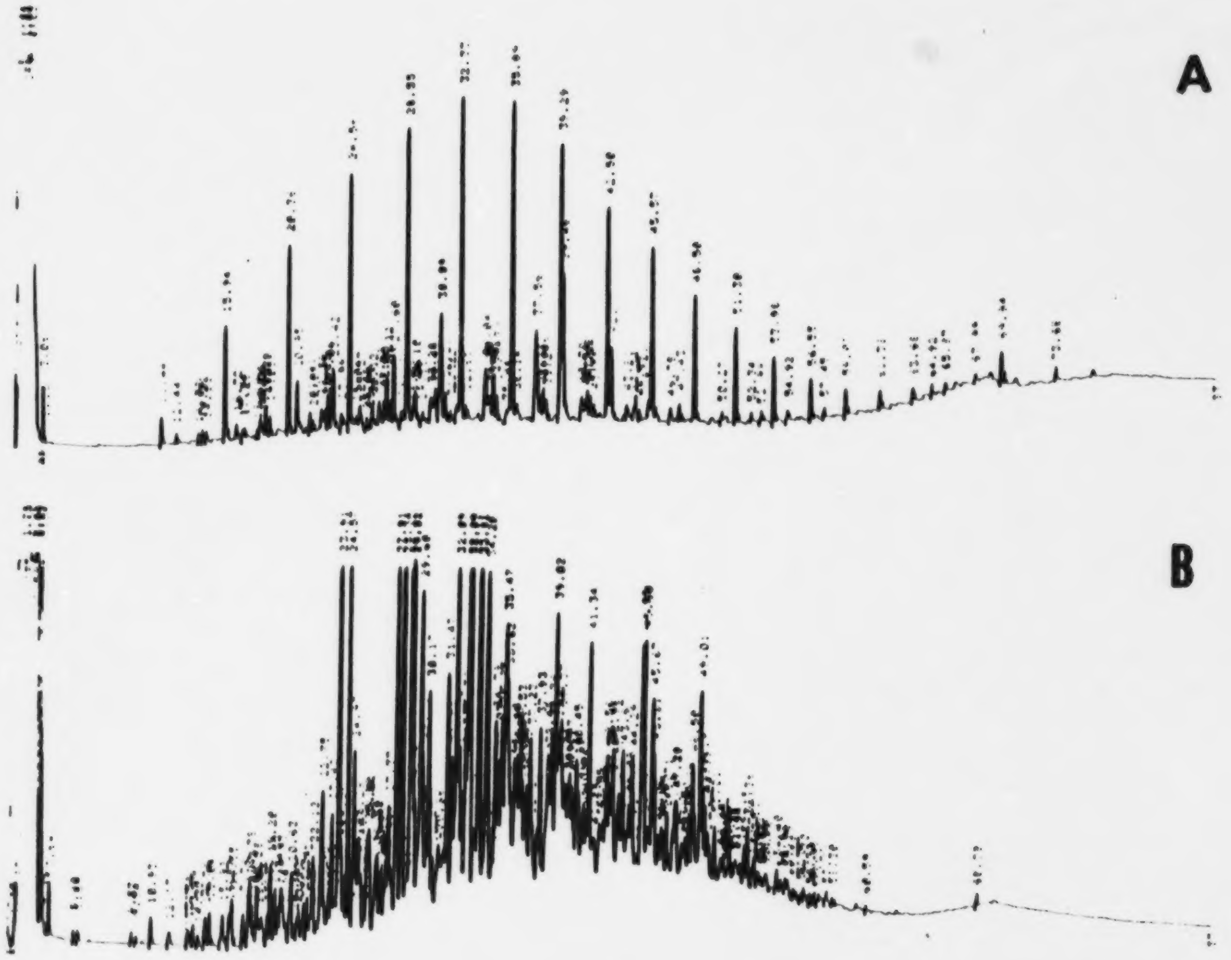


FIGURE IX B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-3.

IXC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

IX C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	$N\text{-}C_9$	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

IX C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

IX C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

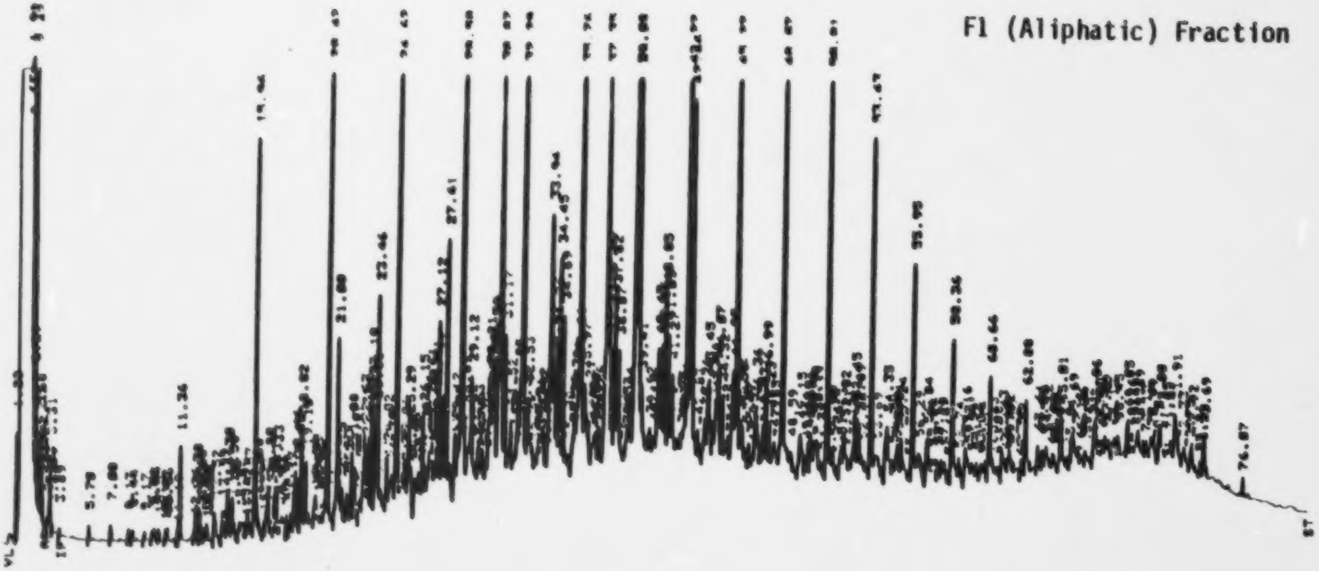


FIGURE IX C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-3.

IX C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	..147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

IX C. P-3 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (µg/l)
Dimethylethylbenzene	1083	4.1
*Methyl-(methylethyl)-benzene	1101	1.6
*Tetramethylbenzene	1115	3.7
*Tetramethylbenzene	1146	4.5
Napthalene	1174	1.3
2-Methylhaphthalene	1291	171
1-Methylnaphthalene	1300	8.9
1,1'-Biphenyl	1371	2.0
*Dimthylnaphthalene	1393	3.4
*Dimethylnaphthalene	1410	2.1
Methyl-1,1-biphenyl	1481	3.1
Methylethylnaphthalene	1494	12.0
*Trimethylnaphthalene	1519	8.2
*Trimethylnaphthalene	1524	18.2
*Trimethylnaphthalene	1538	4.8
*Trimethylnaphthalene	1554	1.9
*Trimethylnaphthalene	1570	1.6
Methldibenzothiophene	1838	4.9

IX C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

F2 (Aromatic) Fraction

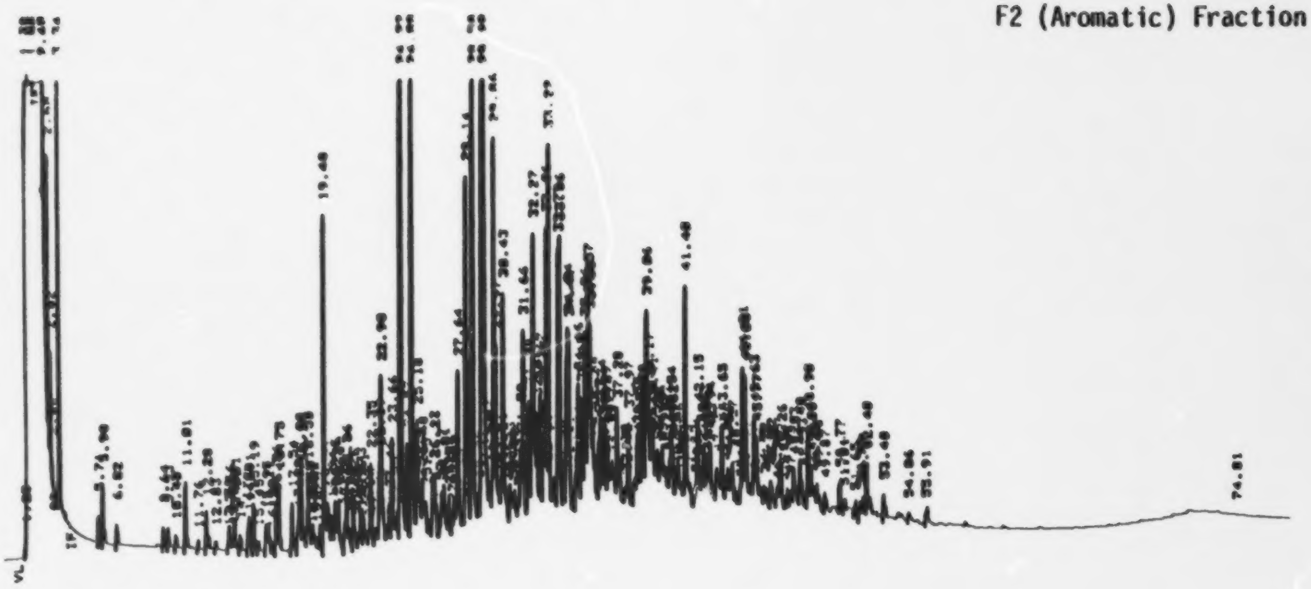
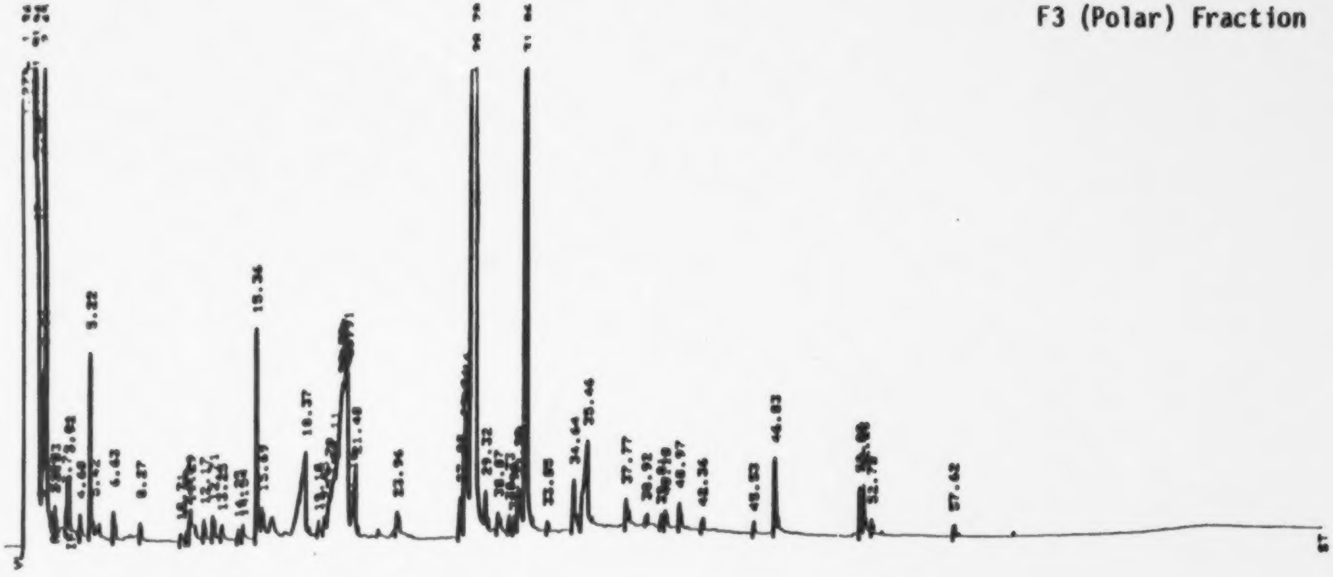


FIGURE IX C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-3.

83 - 2002 F3



F3 (Polar) Fraction

FIGURE IX C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-3.

IX D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/1)	Total Unresolved Components (mg/1)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

IX D (cont.) P-3 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPCNENTS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
C_7-Alcohol	909	2.3
C_8-Alcohol	1020	31.3
Benzoic Acid	1226	48.5
Methoxybenzaldehyde	1410	68.5
C_{13}-Ketone	1488	3.0
Molecular Ion m/e = 170	1553	4.7
Methoxybenzoic Acid	1590	15.8
Molecular Ion m/e = 199	1676	11.5
C_{18}-Carboxylic Acid	2162	7.8

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[a] Concentrations expressed per unit volume of wet sample.

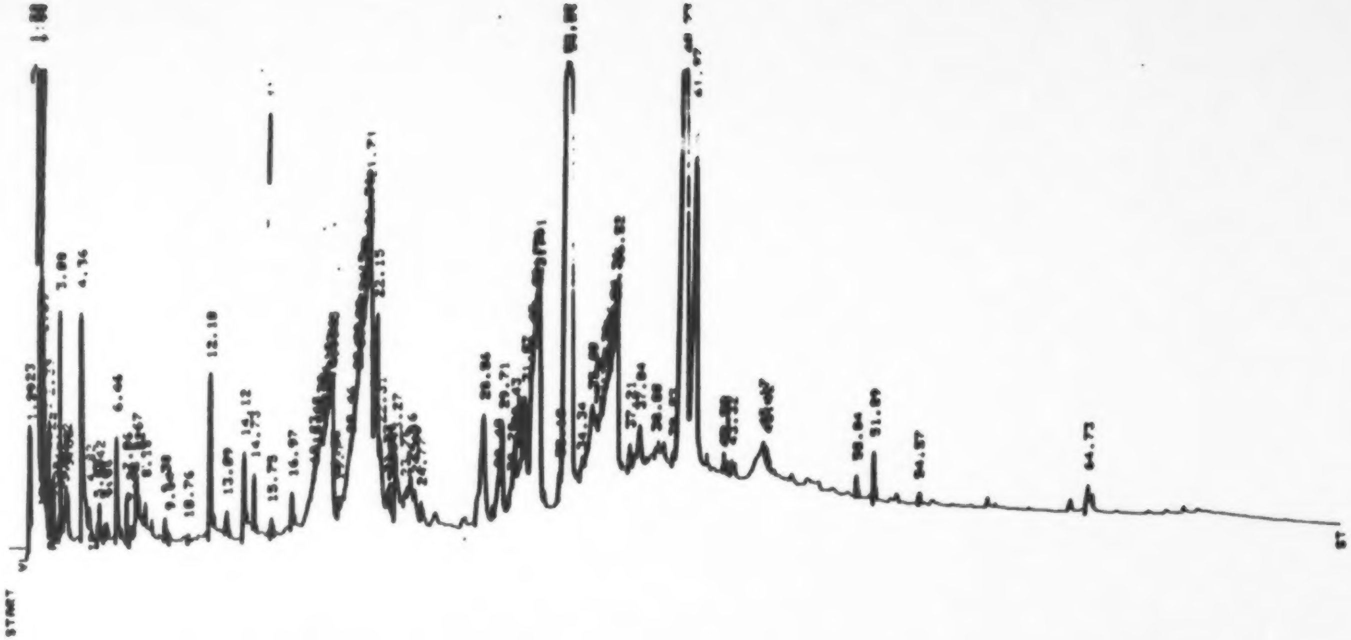

FIGURE IX D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-3.

X. MUD IDENTIFICATION: P4-1-3

LAB NUMBER: 83-2003

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

X A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P4-1-3 (Sample I.D.: 83-2003)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	1.56(%)	1083.	2.41
Ba	48.7(%)	11.7	10.7
Cd	8.27	3.06	0.004
Ca	0.18(%)	—	—
Cr	532.	197.	41.8
Cu	32.7	12.3	0.059
Fe	1.15(%)	2896.	32.4
Pb	221.	28.2	1.56
Sr	207.	—	—
Zn	1384.	476.	0.804
H_2O	60.2 (%)	—	—

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

X B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

X B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

X B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

X B(cont). P-4 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Methylethylbenzene	959	94.7
Trimethylbenzene	990	126.
*Methylpropylbenzene	1048	102.
Dimethylethylbenzene	1055	52.2
*Methylpropylbenzene	1063	56.6
*Methyl-(methylethyl)-benzene	1074	168.
Dimethylethylbenzene	1081	118.
*Methyl-(methylethyl)-benzene	1101	190.
Tetramethylbenzene	1115	49.0
Methylpropenylbenzene	1143	267.
Dimethylpropylbenzene	1161	168.
Naphthalene	1175	196.
2-Methylnaphthalene	1285	1420.
1-Methylnaphthalene	1301	820.
1,1'-Biphenyl	1372	355.
*Dimethylnaphthalene	1395	1880.
*Dimethylnaphthalene	1413	97.7
*Dimethylnaphthalene	1429	422.
*Dimethylnaphthalene	1445	436.
Methyl-1,1'-biphenyl	1479	766.
Methylethylnaphthalene	1496	756.
*Trimethylnaphthalene	1518	477.
*Trimethylnaphthalene	1523	764.
*Trimethylnaphthalene	1539	1980.
*Trimethylnaphthalene	1555	1800.
*Trimethylnaphthalene	1572	466.
*Methylethylnaphthalene	1642	681.
*Methylethylnaphthalene	1663	434.
Phenanthrene	1767	556.
Methyldibenzothiophene	1841	378.
*Methylphenanthrene	1883	436.
*Methylphenanthrene	1888	255.
*Methylphenanthrene	1907	253.
*Dimethylphenanthrene	2004	341.
*Dimethylphenanthrene	2022	382.

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

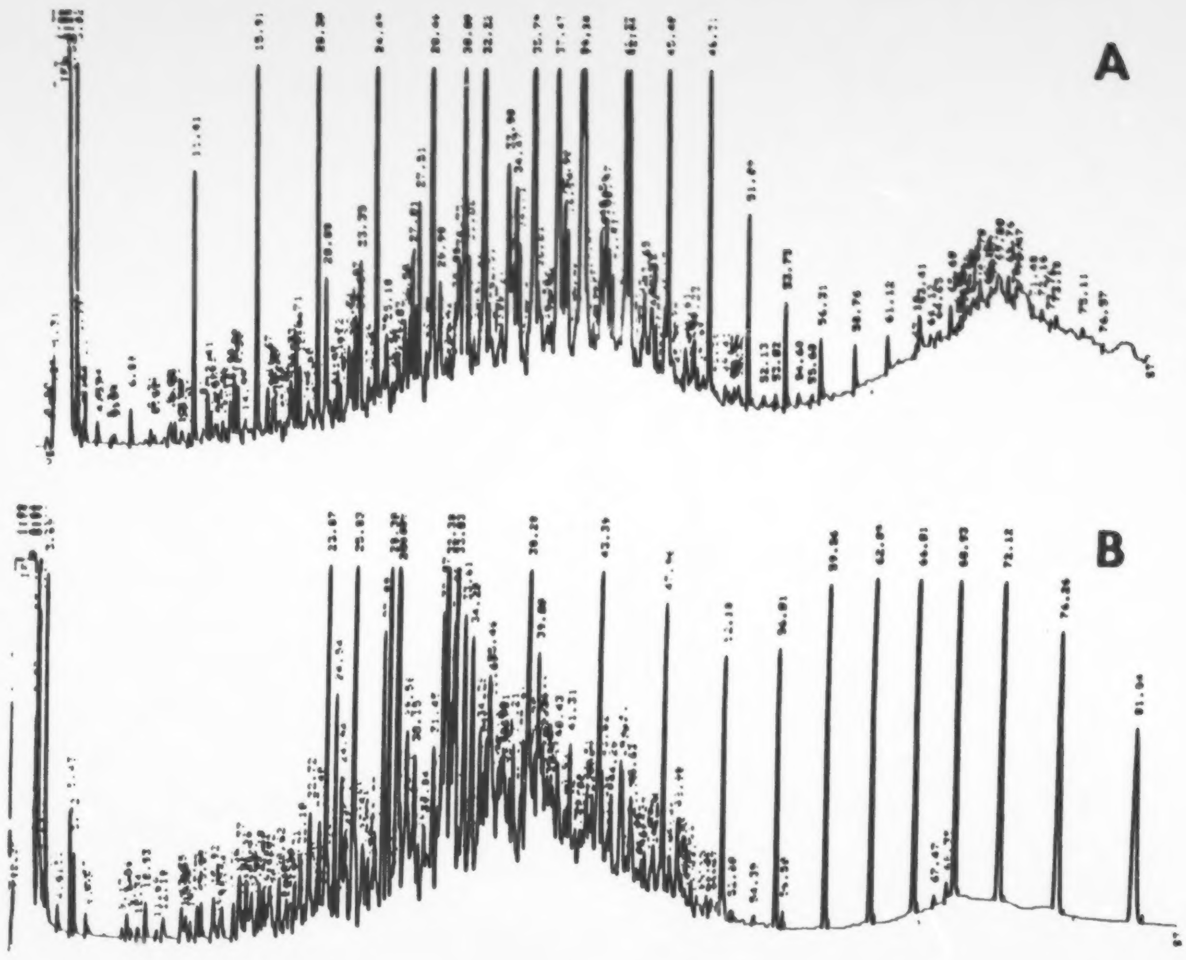

FIGURE X B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-4.

X C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

X C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

X C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

X C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

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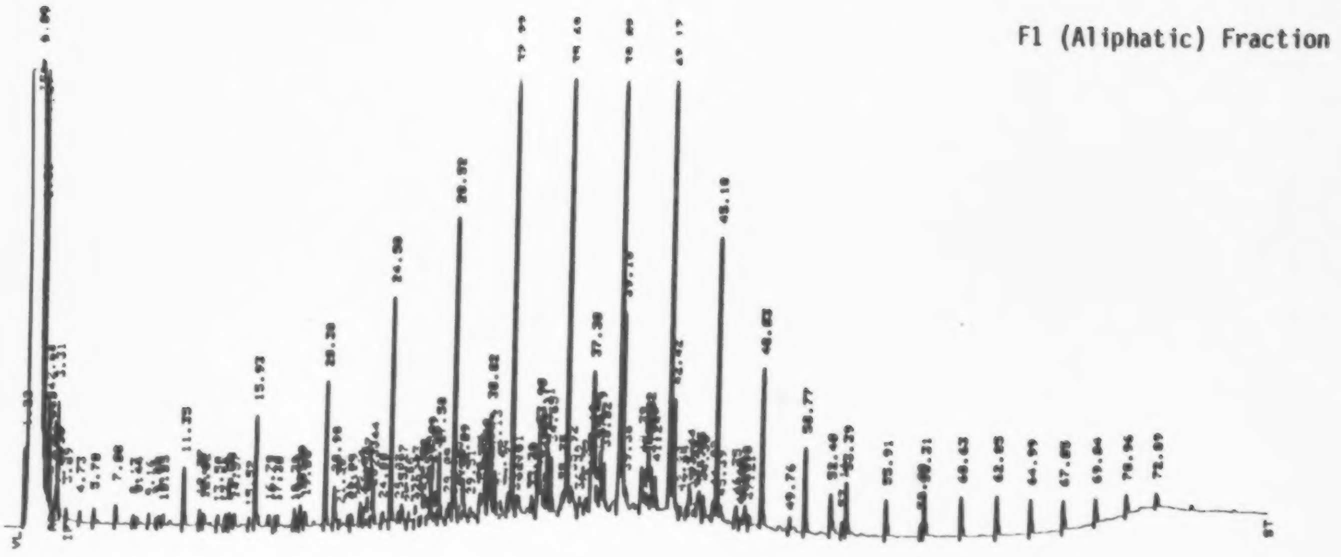

FIGURE X C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-4.

X C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.55	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

X C. P-4 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
Trimethylbenzene	993	0.60
Dimethylethylbenzene	1055	0.25
Tetramethylbenzene	1115	0.41
Methylpropenylbenzene	1143	0.15
Naphthalene	1175	0.19
2-Methylnaphthalene	1284	0.25
1-Methylnaphthalene	1206	7.9
1,1'Biphenyl	1371	0.38
*Dimethylnaphthalene	1393	0.38
*Dimethylnaphthalene	1416	7.7
Methyl-1,1'-biphenyl	1480	0.17
Methylethylnaphthalene	1494	1.8
*Trimethylnaphthalene	1519	0.9
*Trimethylnaphthalene	1524	2.9
*Trimethylnaphthalene	1553	0.36
*Trimethylnaphthalene	1570	0.27
*Methylethylnaphthalene	1640	0.28
*Methylphenanthene	1891	1.3
*Dimethylphenanthene	2004	0.21

F2 (Aromatic) Fraction

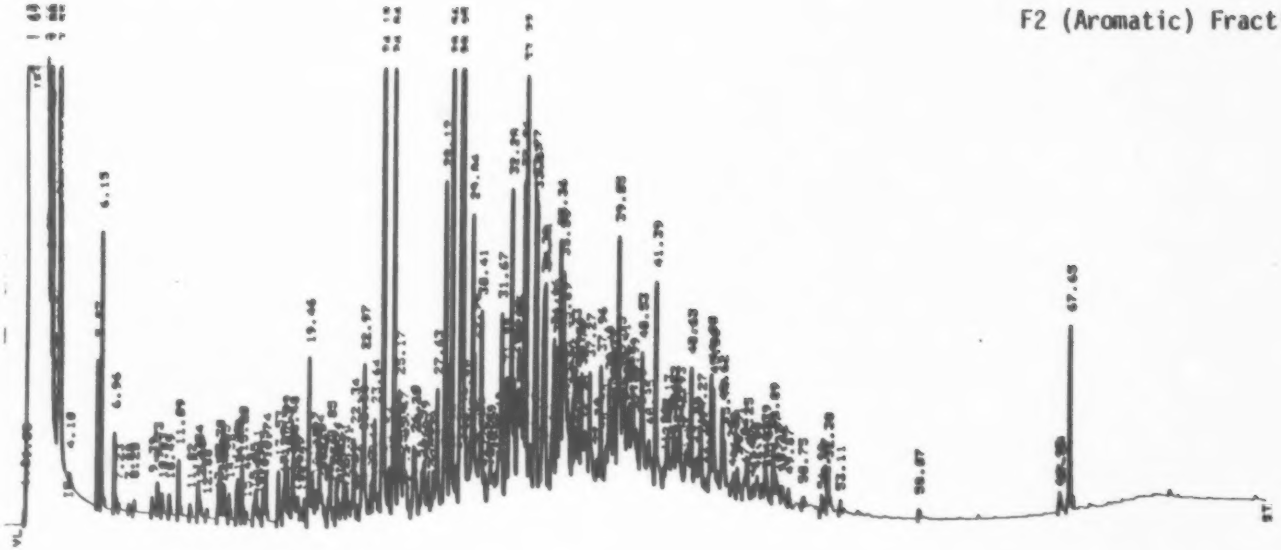

FIGURE X C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-4.

X C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

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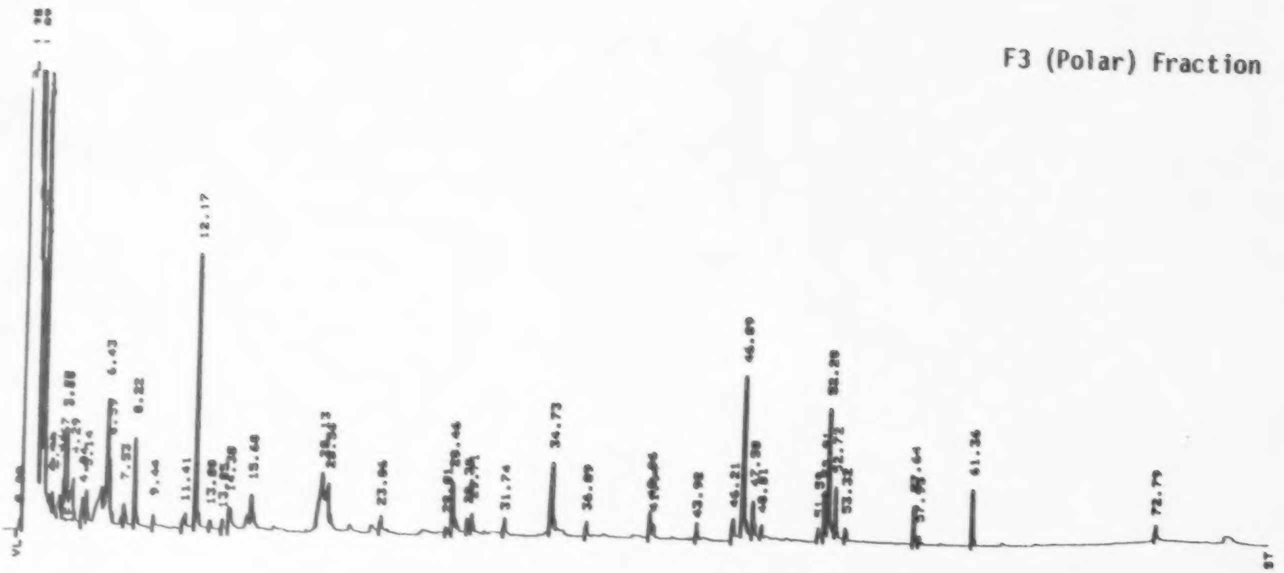

FIGURE X C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-4.

X D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/1)	Total Unresolved Components (mg/1)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

X D. (cont) P-4 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l) [a]
C_7-Alcohol	910	<0.1
C_8-Alcohol	1023	<0.1
Ethylhexanol	1037	<0.1
Methoxybenzaldehyde	1415	<0.1
C_{13}-Ketone	1497	<0.1
Molecular Ion m/e = 170	1556	<0.1
Methoxybenzoic Acid	1589	<0.1
Hexadecanoic Acid	1978	<0.1
C_{18}-Carboxylic Acid	2161	<0.1
C_{20}-Carboxylic Acid	2442	<0.1

[a] Concentrations expressed per unit volume of wet sample.

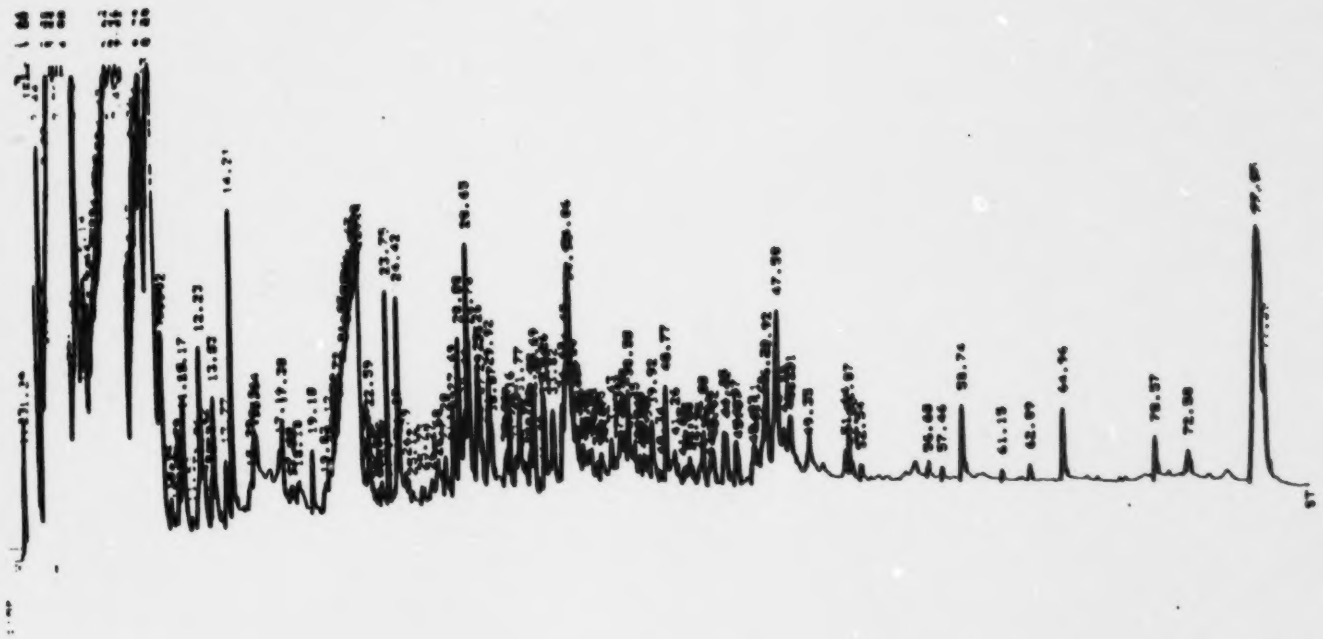

FIGURE X D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-4.

XI. MUD IDENTIFICATION: P5-1-3

LAB NUMBER: 83-2004

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

XI A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P5-1-3 (Sample I.D.: 83-2004)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	0.71(%)	376.	0.354
Ba	37.5(%)	15.9	1.04
Cd	2.34	0.075	0.003
Ca	0.57(%)	—	—
Cr	187.	34.6	0.513
Cu	126.	10.6	0.373
Fe	7.63(%)	1996.	1.60
Pb	104.	9.07	0.054
Sr	346.	—	—
Zn	175.	27.5	0.007
H_2O	57.5 (%)	—	—

[a] Concentrations expressed as µg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as µg/g wet weight unless otherwise indicated.

XI B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/l)	UCM (mg/l)	Resolved (mg/l)	UCM (mg/l)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

XI B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

XI B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

XI B. (cont.) P-5 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration ($\mu g/l$)[a]
Methylethylbenzene	961	634
Trimethylbenzene	991	815
Methylpropylbenzene	1049	554
*Methyl-(methylethyl)-benzene	1076	867
Dimethylethylbenzene	1083	683
*Methyl-(methylethyl)-benzene	1102	525
Methylpropenylbenzene	1143	1330
Naphthalene	1174	1010
2-Methylnaphthalene	1283	8090
1-Methylnaphthalene	1299	4030
1,1'-Biphenyl	1370	1420
*Dimethylnaphthalene	1394	8130
*Dimethylnaphthalene	1409	4930
*Dimethylnaphthalene	1428	1320
*Dimethylnaphthalene	1443	2050
Methyl-1,1'-biphenyl	1478	4090
Methylethylnaphthalene	1495	3960
*Trimethylnaphthalene	1517	2750
*Trimethylnaphthalene	1522	4020
*Trimethylnaphthalene	1538	7820
*Trimethylnaphthalene	1554	6720
*Trimethylnaphthalene	1571	2190
*Methyl-(methylethyl)-Naphthalene	1642	2760
*Methyl-(methylethyl)-Naphthalene	1663	1720
Phenanthrene	1767	2430
Methyldibenzothiophene	1841	1670
*Methylphenanthrene	1883	2370
*Methylphenanthrene	1888	1310
*Methylphenanthrene	1907	1490
*Dimethylphenanthrene	2005	2560
*Dimethylphenanthrene	2023	2310

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

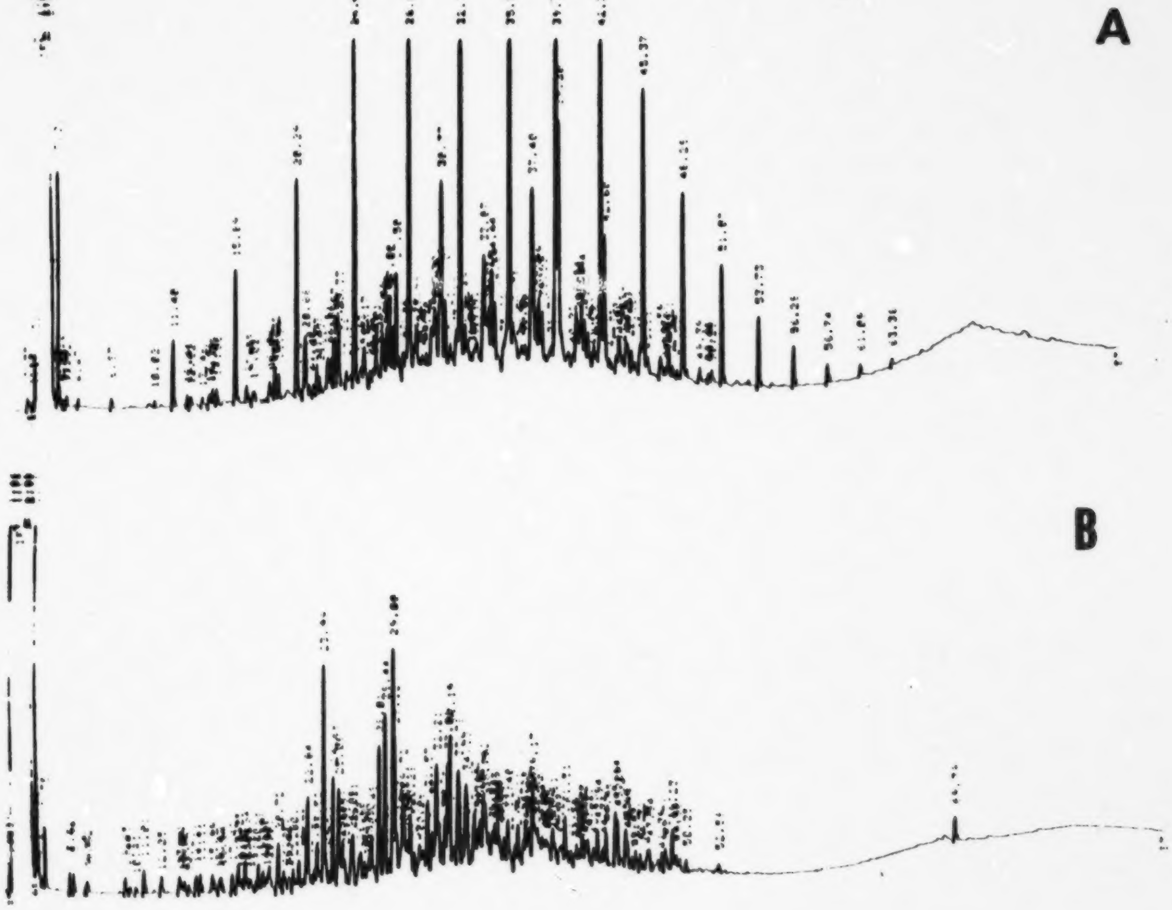

FIGURE XI B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-5.

XI C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

XI C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

XI C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

XI C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (µg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

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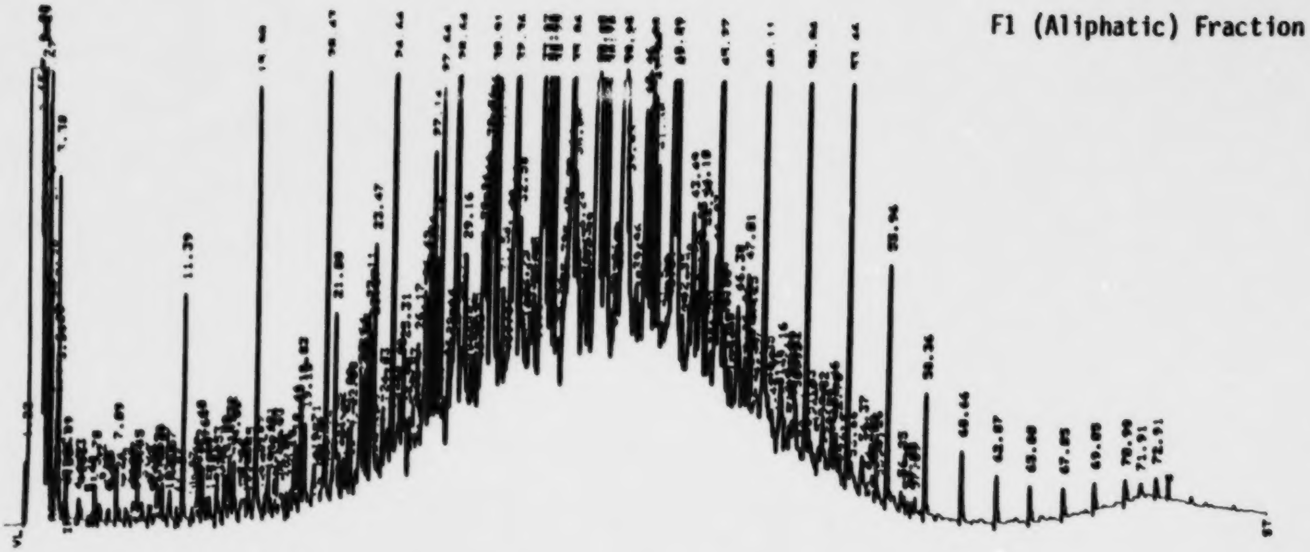

FIGURE XI C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-5.

XI C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.5[illegible]	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

XI C. P-5 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (µg/l)
*Methyl-(methylethyl)-benzene	1076	0.27
Dimethylethylbenzene	1083	1.9
Methylpropenylbenzene	1143	0.31
Naphthalene	1174	0.34
2-Methylnaphthalene	1291	0.84
1-Methylnaphthalene	1299	0.84
1,1'-Biphenyl	1372	0.75
*Dimethylnaphthalene	1393	0.31
*Dimethylnaphthalene	1409	0.84
Methy-1,1'-biphenyl	1476	0.36
Methylethylnaphthalene	1494	2.9
*Trimethylnaphthalene	1514	1.5
*Trimethylnaphthalene	1520	2.4
*Trimethylnaphthalene	1538	1.2
*Trimethylnaphthalene	1554	0.88
*Trimethylnaphthalene	1571	1.0
*Methyl-(methylethyl)-naphthalene	1662	0.73
Phenanthene	1770	0.44
Methyldibenzothiophene	1840	2.5
*Methylpehnanthene	1885	0.96
*Methylphenanthene	1890	0.31

XI C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (µg/l)	Unresolved (µg/l)	Total (µg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

83 - 2004 F3

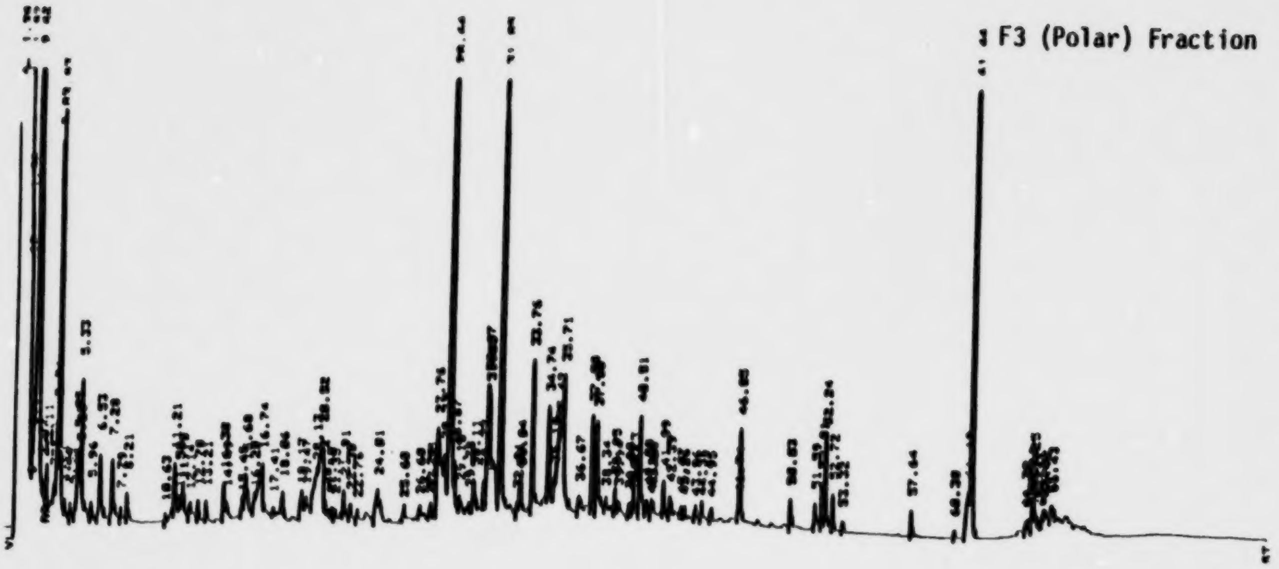

FIGURE XI C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-5.

XI D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

XI D. (cont.) P-5 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (µg/l)[a]
C_7-Alcohol	911	13.5
C_8-Alcohol	1022	6.0
Ethylhexanol	1035	2.3
C_9-Ketone	1066	2.8
Benzoic Acid	1234	.3
Methoxybenzaldehyde	1411	3.4
C_{13}-Ketone	1500	15.7
Molecular Ion m/e = 170	1550	.8
C_{18}-Carboxylic Acid	2162	1.2
C_{19}-Carboxylic Acid	2304	1.0
C_{19}-Carboxylic Acid	2447	4.1

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[a] Concentrations expressed per unit volume of wet sample.

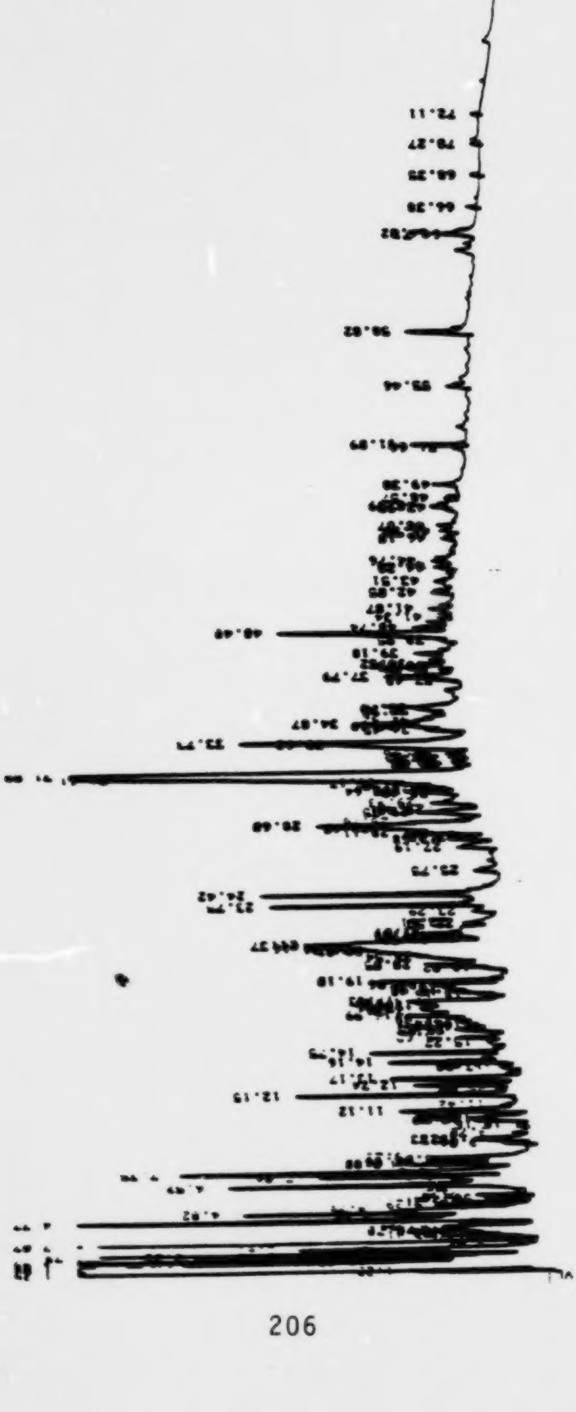

FIGURE XI D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-5.

XII. MUD IDENTIFICATION: P6-1-2

LAB NUMBER: 83-3312

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

XII A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P6-1-2 (Sample I.D.: 83-3312)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	5.10(%)	1012.	0.021
Ba	18.8(%)	15.8	0.134
Cd	10.5	0.556	0.017
Ca	0.19(%)	—	—
Cr	41.8	1.06	0.227
Cu	35.1	2.18	0.002
Fe	2.51(%)	1243.	0.108
Pb	210.	10.2	0.003
Sr	120.	—	—
Zn	1755.	80.4	0.007
H_2O	78.1(%)	—	—

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

83 - 3312 F1

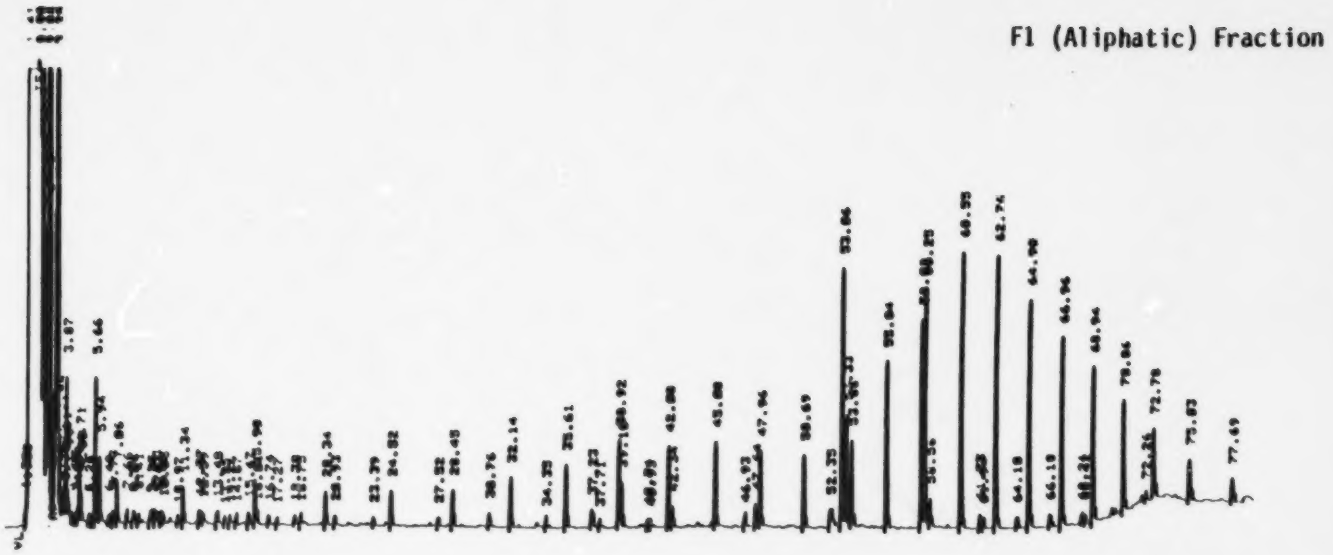

FIGURE XII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-6.

XII B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/l)	UCM (mg/l)	Resolved (mg/l)	UCM (mg/l)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

XII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

XII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

XII B. (cont.)P-6 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Trimethylbenzene	992	10.7
Naphthalene	1178	11.3
2-Methylnaphthalene	1288	30.4
1-Methylnaphthalene	1304	24.0
*Dimethylnaphthalene	1398	33.6
*Dimethylnaphthalene	1413	14.5
*Dimethylnaphthalene	1433	23.5
*Dimethylnaphthalene	1448	10.1
Methyl-1,1'-biphenyl	1482	13.4
Methylethylnaphthalene	1498	9.01
*Trimethylnaphthalene	1521	7.69
*Trimethylnaphthalene	1525	15.8
*Trimethylnaphthalene	1541	35.6
*Trimethylnaphthalene	1557	42.1
Methyl-(methylethyl)-Naphthalene	1666	8.56
Phenanthrene	1771	24.2
*Methylphenanthrene	1886	9.73
*Methylphenanthrene	1911	9.27
Dimethylphenanthrene	2027	8.13

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

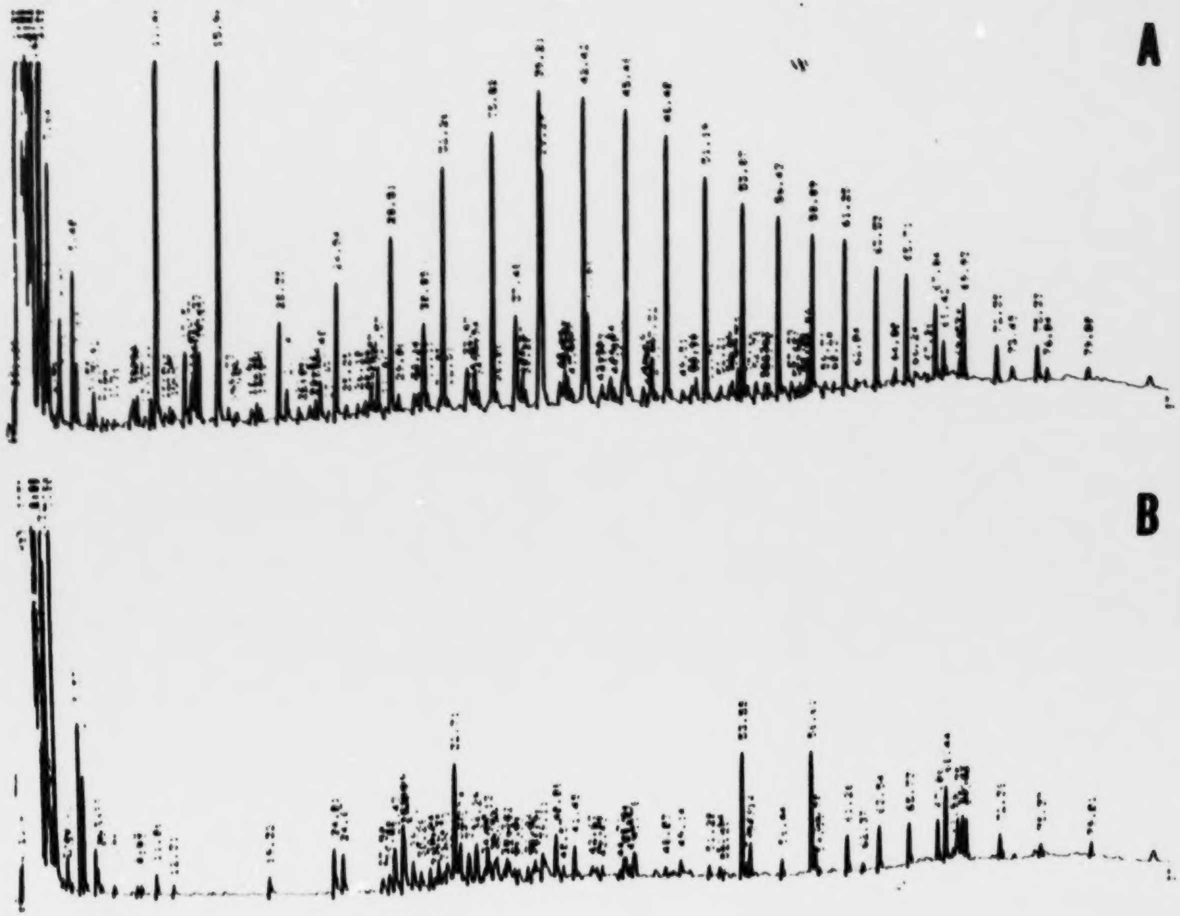

FIGURE XII B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-6.

XII C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

XII C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	$N\text{-}C_9$	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

XII C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

XII C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

XII C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.5	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

XII C. P-6 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
2-Methylnaphthalene	1291	0.07
1-Methylnaphthalene	1307	0.06

83 - 3312 F2

F2 (Aromatic) Fraction

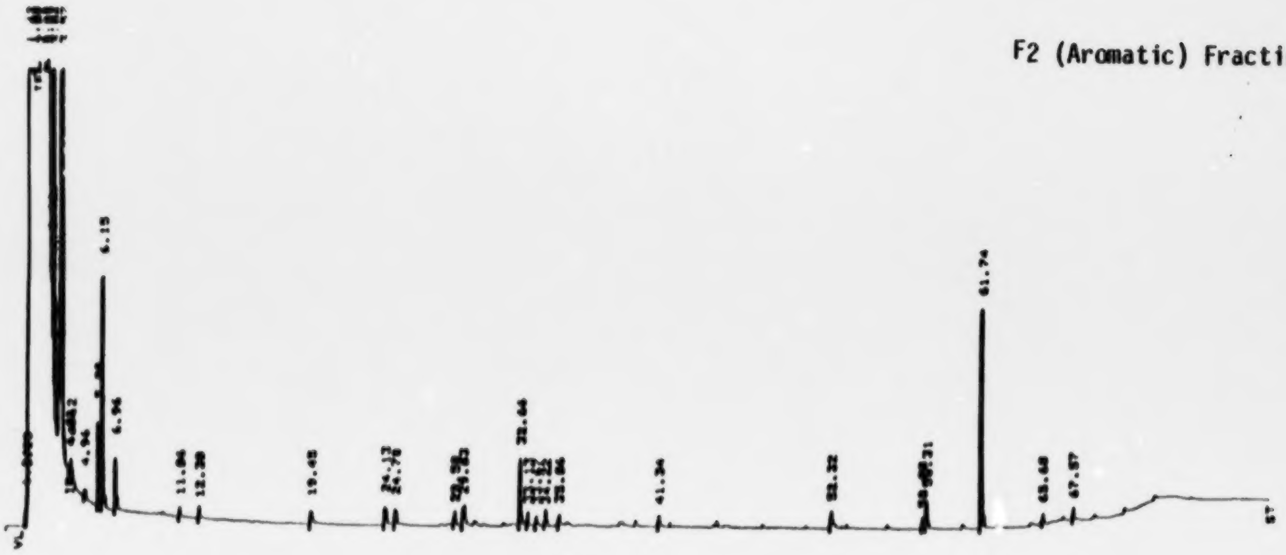

FIGURE XII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-6.

XII C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

83 - 3312 F3

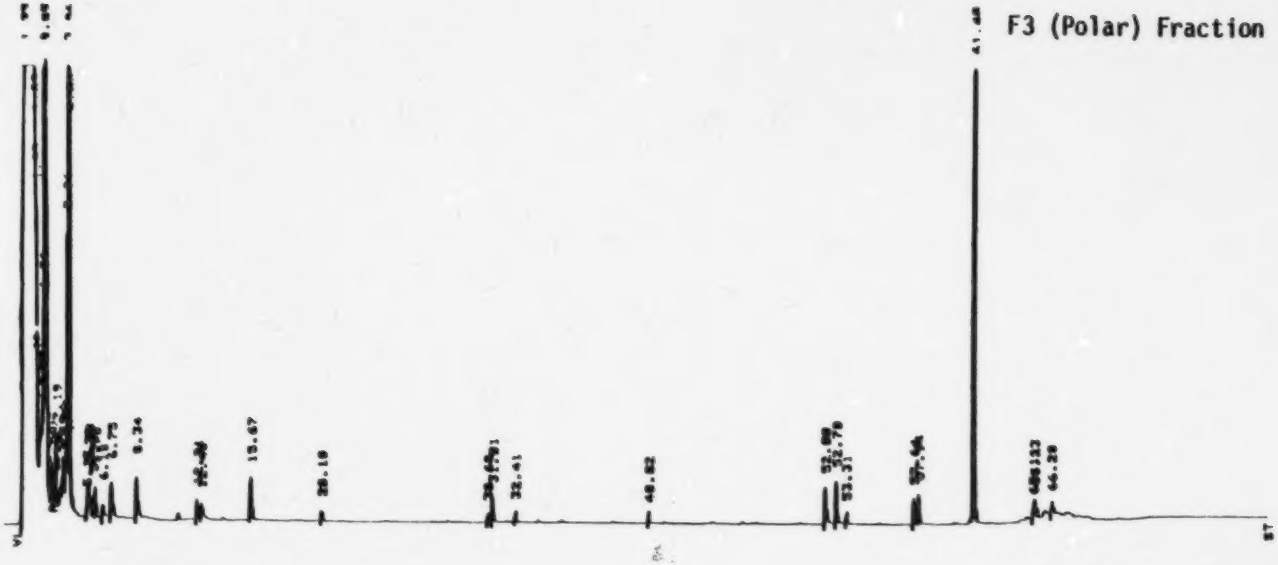

FIGURE XII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-6.

XII D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

XII D. (cont.) P-6 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (µg/l)[a]
C_7-Alcohol	913	.2
C_8-Alcohol	1022	5.5
Ethylhexanol	1033	.1
Benzoic Acid	1219	.1
Molecular Ion m/e = 170	1556	.2
C_{18}-Carboxylic Acid	2160	.4

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[a] Concentrations expressed per unit volume of wet sample.

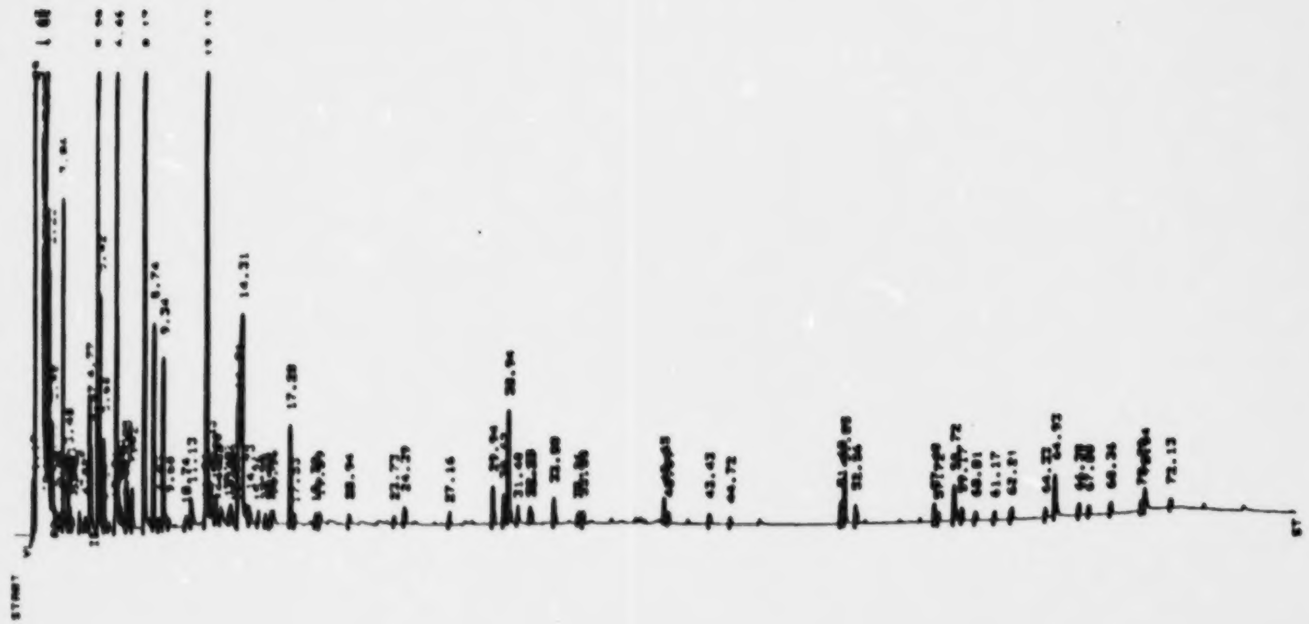

FIGURE XII D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-6.

XIII. MUD IDENTIFICATION: P7-1-2

LAB NUMBER: 83-3313

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. issolved Bioassay Phase Organic Concentrations

XIII A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P7-1-2 (Sample I.D.: 83-3313)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	4.47(%)	1010.	0.011
Ba	21.0(%)	19.4	0.328
Cd	0.21	0.018	0.001
Ca	0.46(%)	—	—
Cr	502.	35.6	0.436
Cu	15.6	0.932	0.021
Fe	2.25(%)	1001.	0.288
Pb	92.1	1.45	0.004
Sr	258.	—	—
Zn	144.	6.30	0.007
H_2O	69.9	—	—

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

XIIIB. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

Sample #	Aliphatic Fraction		Aromatic Fraction	
	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.[illegible]	69.1	14.1	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

XIII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	$N\text{-}C_9$	$N\text{-}C_{10}$	$N\text{-}C_{11}$	$N\text{-}C_{12}$	$N\text{-}C_{13}$	$N\text{-}C_{14}$	$N\text{-}C_{15}$	$N\text{-}C_{16}$	$N\text{-}C_{17}$	Pristane	$N\text{-}C_{18}$	Phytane	$N\text{-}C_{19}$
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

XIII B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

XIII B(cont). P-7 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (ug/l)[a]
Trimethylbenzene	990	17.3
Methylpropylbenzene	1143	47.0
Naphthalene	1175	25.9
2-Methylnaphthalene	1285	340.
1-Methylnaphthalene	1301	136.
1,1'-Biphenyl	1372	35.9
*Dimethylnaphthalene	1395	339.
*Dimethylnaphthalene	1410	169.
*Dimethylnaphthalene	1429	105.
*Dimethylnaphthalene	1444	90.2
Methyl-1,1'-biphenyl	1479	170.
Methylethylnaphthalene	1496	354.
*Trimethylnaphthalene	1518	106.
*Trimethylnaphthalene	1522	157.
*Trimethylnaphthalene	1555	394.
*Trimethylnaphthalene	1572	102.
*Methyl-(methylethyl)-Naphthalene	1642	224.
*Methyl-(methylethyl)-Naphthalene	1663	109.
Phenanthrene	1767	137.
Methyldibenzothiophene	1841	52.3
*Methylphenanthrene	1888	74.5
*Methylphenanthrene	1883	120.
*Methylphenanthrene	1907	71.8
*Dimethylphenanthrene	2003	107.
*Dimethylphenanthrene	2022	127.

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

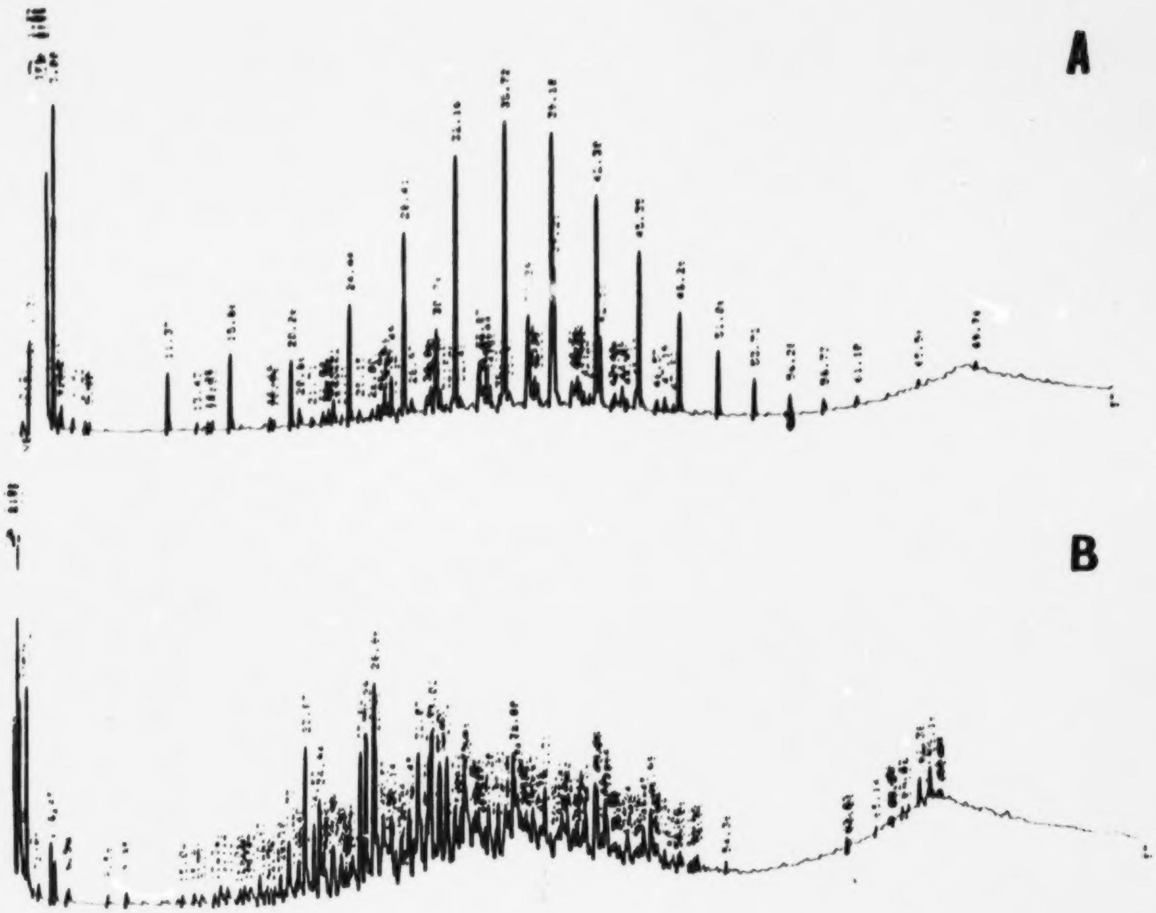

FIGURE XIII B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-7.

XIIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (µg/l)	Unresolved (µg/l)	Total (g/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

XIIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/1)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

XIIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

XIIIC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC_{23}	NC_{24}	NC_{25}	NC_{26}	NC_{27}	NC_{28}	NC_{29}	NC_{30}	NC_{31}	NC_{32}
MIBLKA5I AI-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

F1 (A[illegible]phatic) Fraction

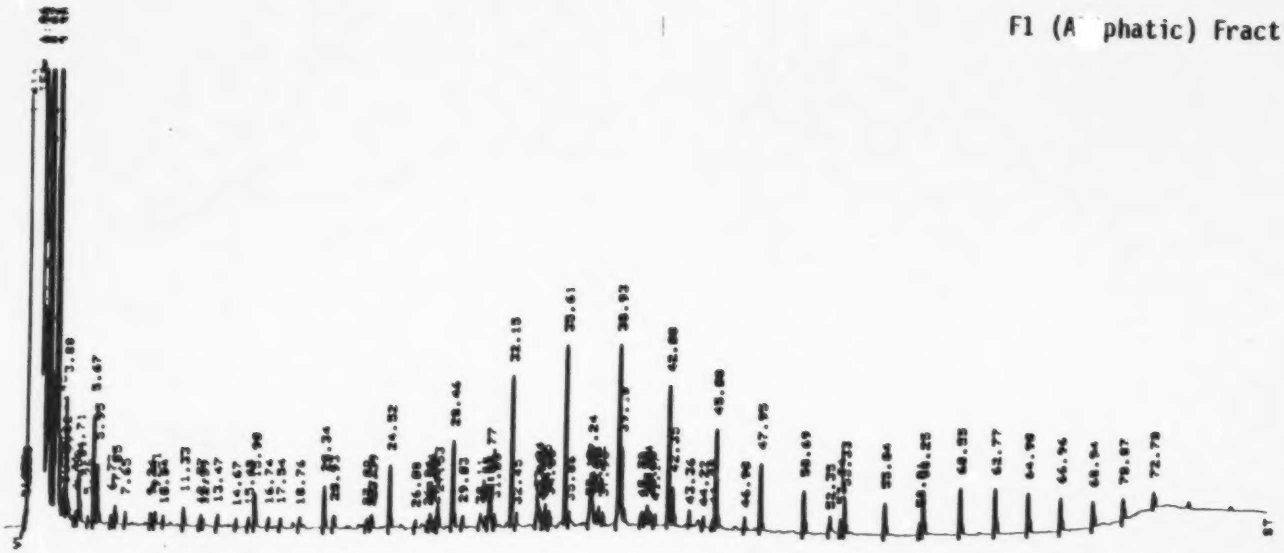

FIGURE XIII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-7.

XIIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.5	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

XIII C. P-7 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
2-Methylnaphthalene	1290	4.1
1-Methylnaphthalene	1306	2.1
*Trimethylnaphthalene	1524	0.48

83 - 3313   F2

F2 (Aromatic) Fraction

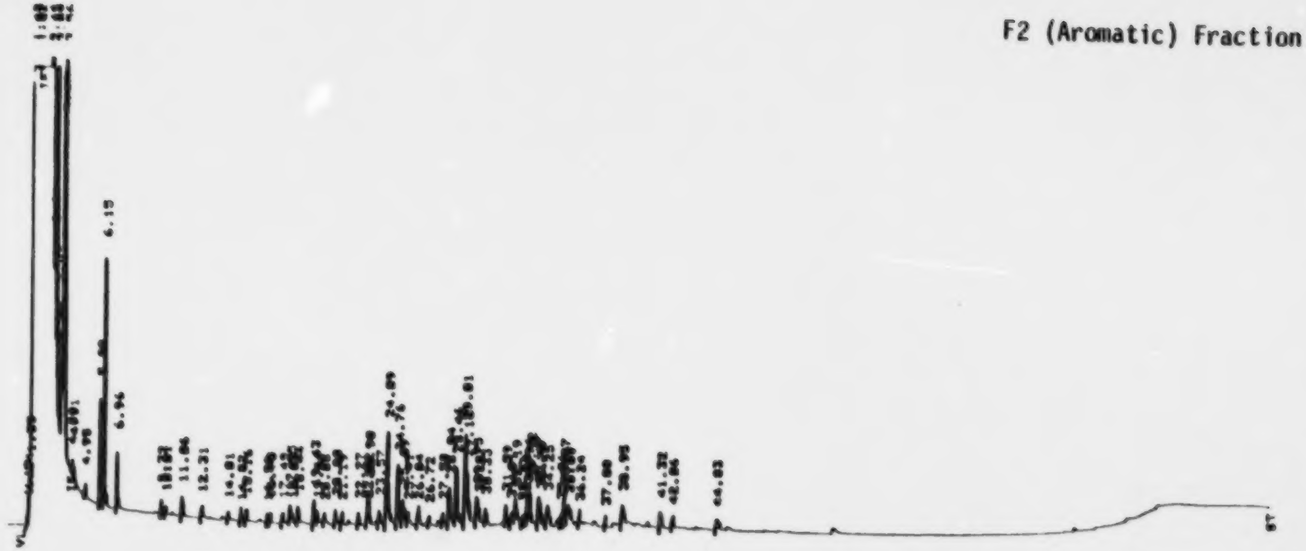

FIGURE XIII C.   CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-7.

XIIIC. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (μg/l)	Unresolved (μg/l)	Total (μg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

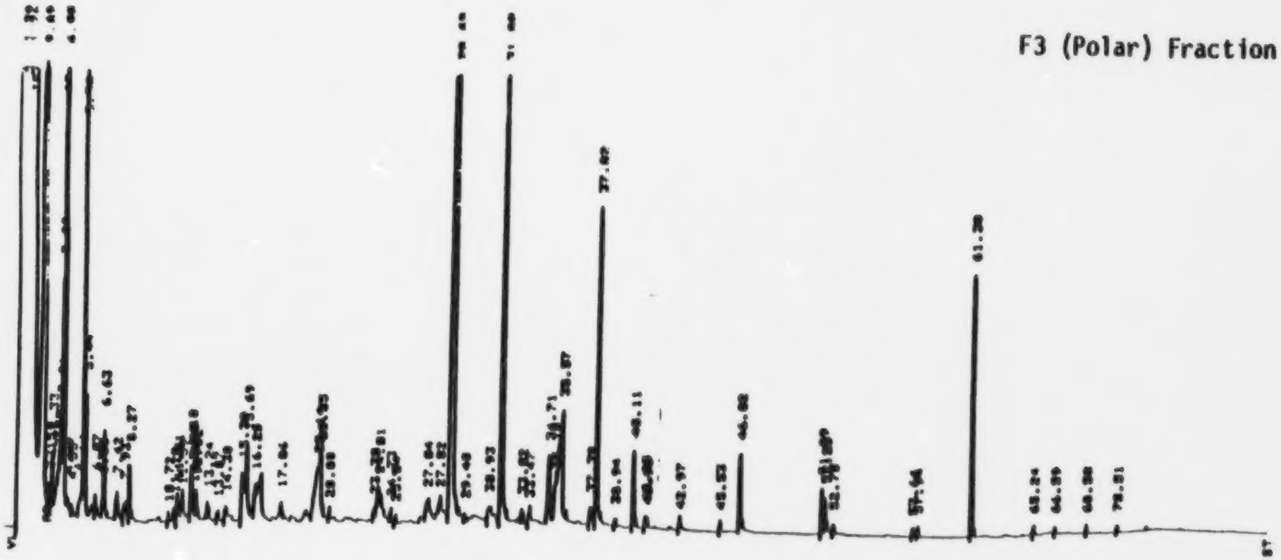

FIGURE XIII C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-7.

XIIID. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

XIII D. (cont.) P-7 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
C_7-Alcohol	912	.4
C_8-Alcohol	1021	9.9
C_9-Ketone	1065	3.4
Benzoic Acid	1221	1.6
Methoxybenzaldehyde	1406	4.9
C_{13}-Ketone	1500	17.5
Molecular Ion m/e = 170	1552	6.2
Methoxybenzoic Acid	1584	8.2
Molecular Ion m/e = 199	1671	1.8
Hexadecanoic Acid	1972	1.4
C_{18}-Carboxylic Acid	2161	1.5

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[a] Concentrations expressed per unit volume of wet sample.

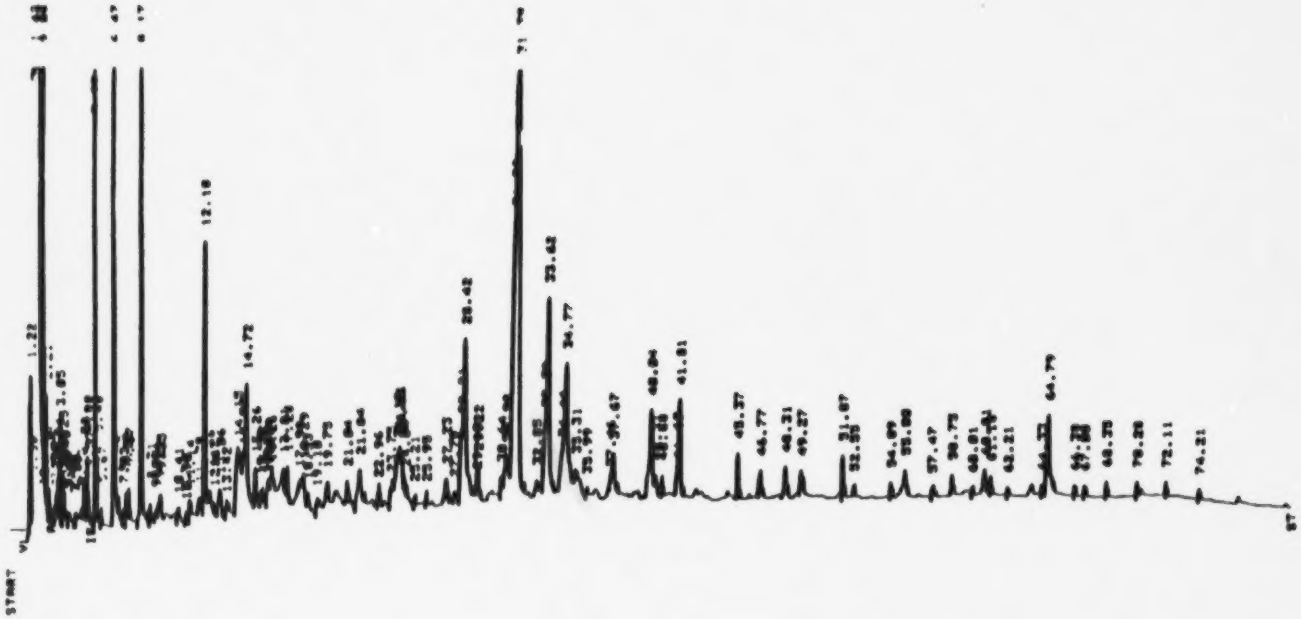

FIGURE XIII D. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "DISSOLVED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-7.

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XIV. MUD IDENTIFICATION: P8-1-1

LAB NUMBER: 83-8537

A. Drilling Mud Elemental Concentrations

B. Whole Drilling Mud Organic Concentrations

C. Particulate Bioassay Phase Organic Concentrations

D. Dissolved Bioassay Phase Organic Concentrations

XIV A. DRILLING MUD ELEMENTAL CONCENTRATIONS

P8-1-1 (Sample I.D.: 83-8537)

Element	Whole Mud[a]	Particulate Phase Bioassay Preparation[b]	Dissolved Phase Bioassay Preparation[b]
Al	0.68(%)	398.	0.026
Ba	3.00(%)	15.9	0.302
Cd	0.410	0.024	0.002
Ca	1.54(%)	—	—
Cr	480.	133.	11.0
Cu	3448.	16.0	0.268
Fe	1.25(%)	802.	1.39
Pb	48.3	5.20	0.199
Sr	1401.	—	—
Zn	144.	22.6	0.185
H_2O	58.1	—	—

[a] Concentrations expressed as μg/g dry weight unless otherwise indicated.

[b] Concentrations expressed as μg/g wet weight unless otherwise indicated.

XIV B. WHOLE MUD - RESOLVED AND UNRESOLVED ORGANIC COMPONENT CONCENTRATIONS*

	Aliphatic Fraction		Aromatic Fraction	
Sample #	Resolved (mg/1)	UCM (mg/1)	Resolved (mg/1)	UCM (mg/1)
MIBLKA51 A1-7	34.5	0	9.83	12.3
AN31-1-6	185.	419.	98.5	194.
Milgel	.004	0	.004	0
SV76-2-5	464.	966.	166.	330.
P-1	2,700.	4,200.	636.	964.
P-2	252.	800.	47.6	228.
P-3	1,260.	5,970.	230.	445.
P-4	132.	548.	106.	103.
P-5	284.	646.	207.	183.
P-6	10.1	12.3	6.5	4.5
P-7	32.2	69.1	14.4	25.6
P-8	204.	270.	86.9	164.

*All concentrations expressed per unit volume of wet sample.

XIV B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_9	N-C_{10}	N-C_{11}	N-C_{12}	N-C_{13}	N-C_{14}	N-C_{15}	N-C_{16}	N-C_{17}	Pristane	N-C_{18}	Phytane	N-C_{19}
MIBLKA51 A1-7	-	3640	1100	1540	1810	2030	2420	2420	2250	925	1780	593	1330
AN31-1-6	182	2600	3300	6440	8310	9790	13,600	14,000	10,800	7110	8780	4250	7880
Milgel	55	5400	137	91	182	182	128	73	72	36	56	36	55
SV76-2-5	357	6220	9990	19,200	27,600	33,000	41,500	36,500	26,200	13,900	22,900	7960	19,200
P-1	3450	28,400	101,000	112,000	141,000	151,000	201,000	197,000	194,000	42,900	148,000	43,400	121,000
P-2	385	2440	6340	9050	13,100	17,200	20,000	21,100	12,200	6890	11,900	4060	10,100
P-3	-	5810	28,200	45,500	63,900	77,500	97,500	96,300	92,400	39,500	76,500	26,400	62,700
P-4	181	1650	3170	3640	5430	6800	9470	12,000	11,400	3260	8490	2640	6390
P-5	-	2060	4570	7370	13,200	18,500	24,700	27,600	24,400	7410	18,800	5800	14,000
P-6	30.9	699	684	116	161	214	299	350	360	120	391	107	373
P-7	-	493	690	602	1130	1800	2610	3130	3240	723	2670	808	2010
P-8	1930	4450	8790	10,400	12,600	13,000	15,800	14,900	12,800	6720	8850	2560	6420

*All concentrations expressed per unit volume of wet sample.

XIV B. (cont.) WHOLE DRILLING FLUID - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)*

Sample #	N-C_{20}	N-C_{21}	N-C_{22}	N-C_{23}	N-C_{24}	N-C_{25}	N-C_{26}	N-C_{27}	N-C_{28}	N-C_{29}	N-C_{30}	N-C_{31}
MIBLKA51 A1-7	940	780	478	289	144	111	-	-	-	-	-	-
AN31-1-6	5270	3900	2510	1570	836	521	245	285	-	-	-	-
Milgel	55	55	55	-	-	56	-	-	-	-	-	-
SV76-2-5	13,800	11,300	8040	5330	3460	2280	1440	1740	725	1160	429	1530
P-1	96,400	65,700	41,300	23,300	10,700	5090	-	-	-	-	-	-
P-2	8000	6380	4730	3320	2050	1810	1040	949	398	795	719	-
P-3	53,700	44,600	34,800	23,300	14,500	8860	6540	-	-	-	-	-
P-4	4280	2520	1580	1060	728	615	458	716	461	655	-	-
P-5	11,400	7900	5440	3270	1480	-	-	-	-	-	-	-
P-6	393	353	327	322	268	283	234	315	141	207	118	144
P-7	1550	1120	744	434	234	-	-	-	-	-	-	-
P-8	4260	3060	1860	1040	518	299	-	-	-	-	-	-

*All concentrations expressed per unit volume of wet sample.

XIV B.(cont.) P-8 WHOLE DRILLING FLUID - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT No.	Concentration (μg/l)[a]
Trimethylbenzene	991	234
Dimethylethylbenzene	1060	142
Methyl-(methylethyl)-benzene	1087	250
2-Methylnaphthalene	1287	3350
1-Methylnaphthalene	1303	2060
1,1'-biphenyl	1373	399
*Dimethylnaphthalene	1397	4300
*Dimethylnaphthalene	1412	2340
*Dimethylnaphthalene	1431	1130
*Dimethylnaphthalene	1446	998
Methyl-1,1'-biphenyl	1480	1240
Methylethylnaphthalene	1497	1220
*Trimethylnaphthalene	1519	1280
*Trimethylnaphthalene	1523	1860
*Trimethylnaphthalene	1540	661
*Trimethylnaphthalene	1555	619
*Trimethylnaphthalene	1579	503
Propenylnaphthalene	1586	695
*Methyl-(methylethyl)-Naphthalene	1643	530
*Methyl-(methylethyl)-Naphthalene	1664	811
*Methyl-(methylethyl)-Naphthalene	1680	319
Phenanthrene	1768	1100
*Methylphenanthrene	1884	1030
*Methylphenanthrene	1890	768
*Methylphenanthrene	1909	462
*Methylphenanthrene	1913	171
*Dimethylphenanthrene	2005	374
*Dimethylphenanthrene	2024	784
*Dimethylphenanthrene	2138	302
*Dimethylphenanthrene	2144	189

*Structural isomer(s) of the compound indicated. Exact identification of individual isomer not possible with the GC/MS analytical protocol employed. KOVAT index can be utilized for comparison and evaluation of isomers among samples.

[a] Concentrations expressed per unit volume of wet sample.

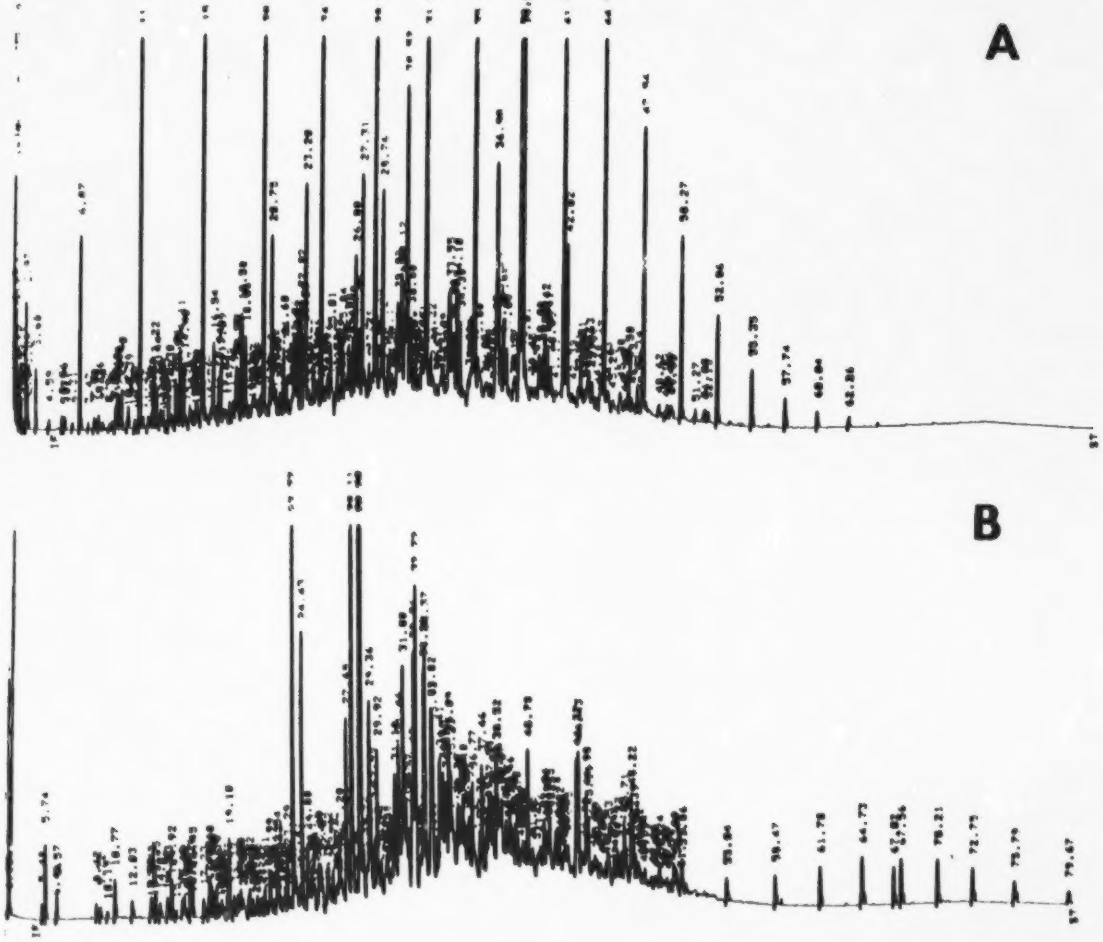

FIGURE XIV B. CAPILLARY COLUMN GAS CHROMATOGRAMS OF THE ALIPHATIC (A) AND AROMATIC (B) FRACTIONS OF WHOLE DRILLING FLUID P-8.

XIV C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED CONCENTRATION - ALIPHATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	0.046	0	0.046
AN31-1-6	0.325	0	0.325
Milgel	0.016	0	0.016
SV76-2-5	1.56	1.96	3.52
P-1	6.43	7.78	14.2
P-2	0.694	0	0.694
P-3	4.35	11.45	15.8
P-4	0.462	0	0.462
P-5	1.55	2.19	3.74
P-6	0.039	0	0.039
P-7	0.063	0	0.063
P-8	0.690	0.68	1.37

XIV C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	N-C_9	NC_{10}	NC_{11}	NC_{12}	NC_{13}	NC_{14}	NC_{15}	NC_{16}	NC_{17}
MIBLKA51 A1-7	—	0.12	0.29	0.46	0.88	0.73	0.34	0.20	0.25
AN31-1-6	—	2.37	7.0	10.7	15.4	18.3	21.7	23.41	23.39
Milgel	0.09	0.25	0.43	0.51	0.69	0.84	0.84	0.91	0.90
SV76-2-5	—	7.58	27.2	52.6	86.7	110	129	119	113
P-1	12.0	72.6	198	274	362	391	448	489	481
P-2	2.7	7.6	14	22	33	42	50	54	51
P-3	—	15	65	124	194	239	289	279	280
P-4	0.96	3.8	8.3	11	19	26	36	46	51
P-5	—	7.0	15	30	62	93	113	132	127
P-6	0.20	0.21	0.24	0.21	0.24	0.25	0.28	0.39	0.57
P-7	—	0.37	0.68	0.97	1.6	2.3	3.2	4.2	4.4
P-8	2.7	8.4	20	28	37	43	46	47	41

XIV C. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	Pristane	NC_{18}	Phytane	NC_{19}	NC_{20}	NC_{21}	NC_{22}
MIBLKA51 A1-7	—	0.11	—	0.15	—	0.14	0.50
AN31-1-6	14.8	17.9	9.0	15.1	9.6	6.8	4.6
Milgel	0.45	0.70	0.29	0.58	0.39	0.28	0.21
SV76-2-5	54.8	85.6	30.1	66.6	43.4	33.0	20.6
P-1	142	368	119	302	203	143	78
P-2	30	41	15	33	24	17	11
P-3	135	229	92	196	171	119	84
P-4	17	36	11	24	13	7.5	4.3
P-5	43	101	39	79	54	37	22
P-6	0.32	0.52	0.17	0.61	0.50	0.56	0.76
P-7	2.0	3.3	1.2	2.5	1.6	1.1	0.83
P-8	23	32	10	25	18	13	8.2

XIVC. DRILLING FLUID SUSPENDED SOLIDS - ALIPHATIC FRACTION CONCENTRATIONS (μg/l)

Sample #	NC$_{23}$	NC$_{24}$	NC$_{25}$	NC$_{26}$	NC$_{27}$	NC$_{28}$	NC$_{29}$	NC$_{30}$	NC$_{31}$	NC$_{32}$
MIBLKA51 A1-7	1.2	2.0	2.9	—	—	—	—	—	—	—
AN31-1-6	3.5	3.6	3.9	4.3	6.0	—	—	—	—	—
Milgel	—	—	0.32	—	—	—	—	—	—	—
SV76-2-5	11.9	7.6	5.2	4.3	5.1	3.0	3.2	2.5	—	—
P-1	36	17	7	—	—	—	—	—	—	—
P-2	6.8	5.3	4.4	4.2	4.8	3.0	3.2	3.1	—	—
P-3	54	44	28	26	—	—	—	—	—	—
P-4	3.3	3.5	3.9	4.3	5.8	3.8	3.4	2.7	—	—
P-5	12	6.3	—	—	—	—	—	—	—	—
P-6	1.30	1.9	2.4	1.9	4.2	2.8	2.6	2.1	1.9	
P-7	0.86	1.1	—	—	—	—	—	—	—	—
P-8	5.3	4.1	4.2	—	—	—	—	—	—	—

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F1 (Aliphatic) Fraction

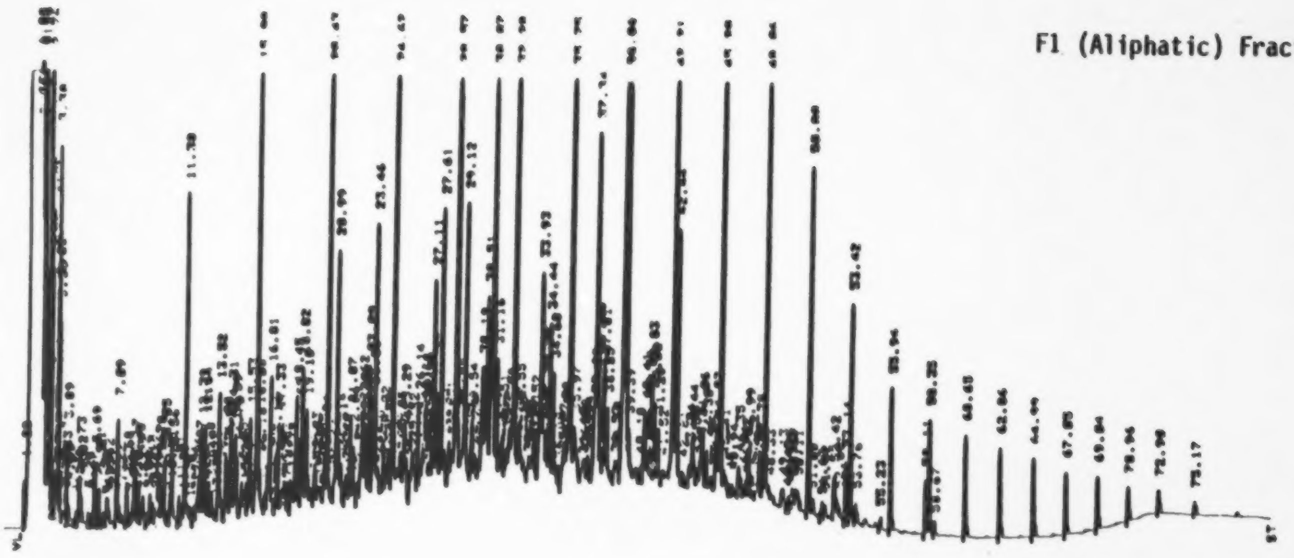

FIGURE XIV C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-8.

XIV C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - AROMATIC FRACTION

Sample #	Resolved (mg/l)	Unresolved (mg/l)	Total (mg/l)
MIBLKA51 A1-7	.072	0	.073
AN 31-1-6	.088	0	.089
Milgel	.15	0	.147
SV76-2-5	.48	.433	.912
P-1	2.5	3.060	5.53
P-2	.29	.134	.426
P-3	1.36	1.50	2.86
P-4	.28	0.17	.442
P-5	.53	1.83	1.37
P-6	.038	0	.038
P-7	.030	0	.030
P-8	1.10	0.61	1.71

XIV C. P-8 SUSPENDED PHASE - AROMATIC FRACTION CONCENTRATIONS

Compound Name	KOVAT #	Concentration (μg/l)
Trimethylbenzene	993	10.1
Dimethylethylbenzene	1058	3.0
2-Methylnaphthalene	1292	109
1-Methylnaphthalene	1308	70
1,1'-bipheny	1378	12.8
*Dimethylnaphthalene	1394	3.3
*Dimethylnaphthalene	1418	47.3
*Dimethylnaphthalene	1445	1.0
Methyl-1,1'-bipheny	1481	2.3
Methylethylnaphthalene	1494	8.5
*Trimethynaphthalene	1520	5.5
*Trimethynaphthalene	1525	15.3
*Trimethynaphthalene	1555	1.2
*Trimethynaphthalene	1580	12.3
Propenylnaphthalene	1585	6.2
*Methyl-(methylethyl)-naphthalene	1642	1.3
*Methyl-(methylethyl)-naphthalene	1664	0.55
*Methyl-(methylethyl)-naphthalene	1678	1.3
*Methylphenanthene	1892	7.8
*Methylphenanthene	1906	0.45
*Dimethylphenanthene	2005	0.65
*Dimethylphenanthene	2146	0.95

83 - 8537 F2

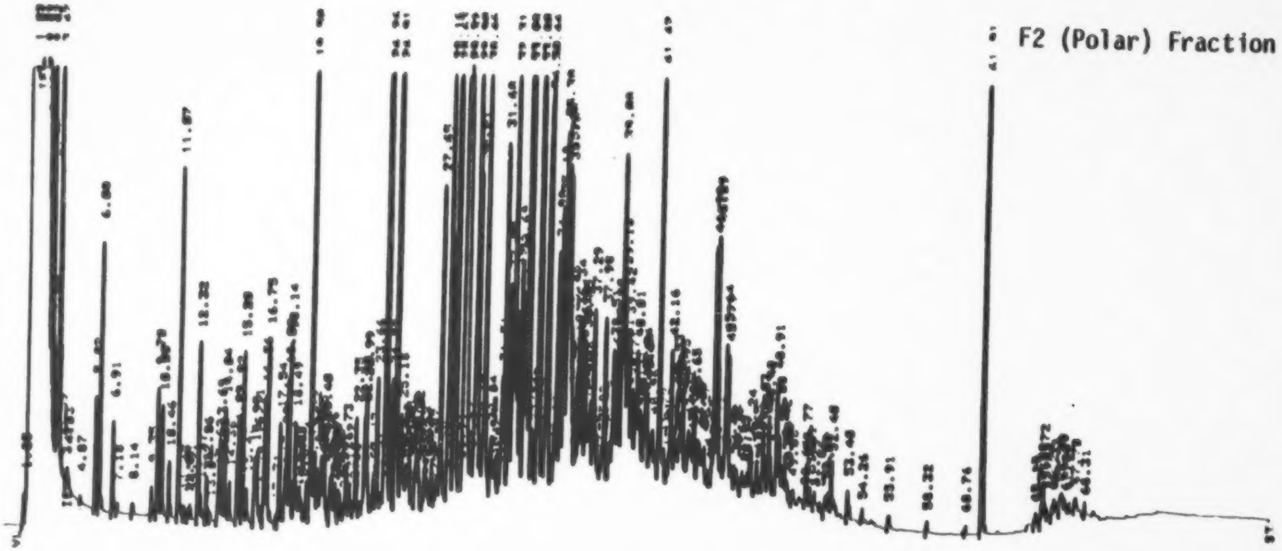

FIGURE XIV C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-8.

XIV C. SUSPENDED PHASE - RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS - POLAR FRACTION

Sample #	Resolved (µg/l)	Unresolved (µg/l)	Total (µg/l)
MIBLKA51 A1-7	25.0	0	25.0
AN 31-1-6	497	0	497
Milgel	118	0	118
SV76-2-5	1630	0	1630
P-1	950	0	950
P-2	1380	0	1380
P-3	1120	0	1120
P-4	147	0	147
P-5	165	0	165
P-6	13.6	0	13.6
P-7	478	0	478
P-8	836	0	836

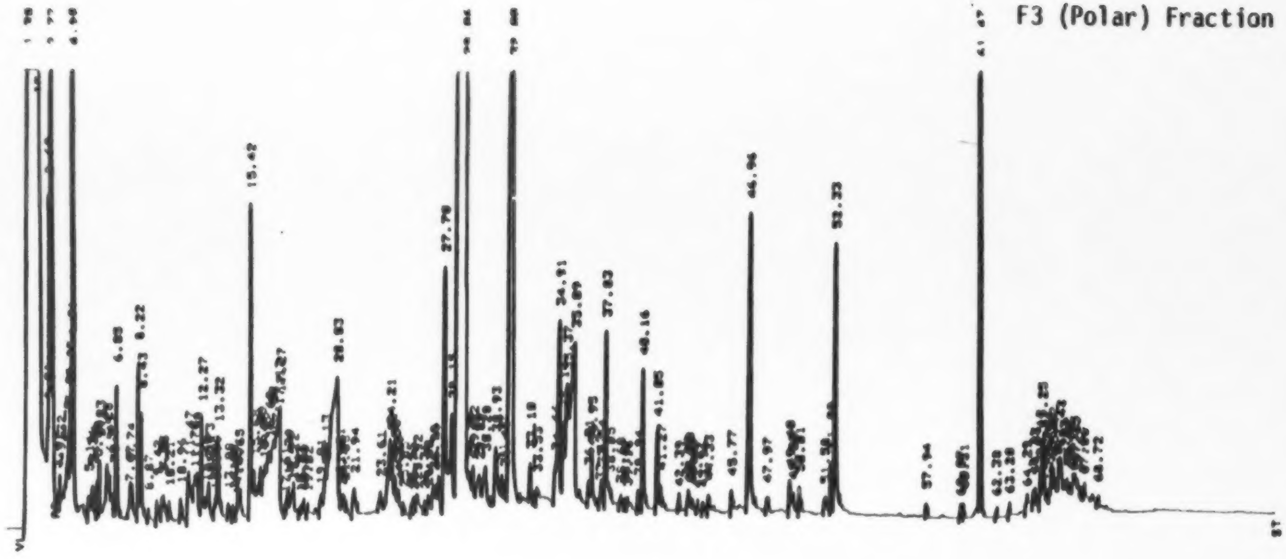

FIGURE XIV C. CAPILLARY COLUMN GAS CHROMATOGRAM OF THE "SUSPENDED PHASE" BIOASSAY PREPARATION OF SPENT DRILLING FLUID P-8.

XIV D. DISSOLVED BIOASSAY PHASE - TOTAL RESOLVED AND UNRESOLVED COMPONENT CONCENTRATIONS*

Sample #	Total Resolved Components (mg/l)	Total Unresolved Components (mg/l)
MIBLKA51 A1-7	.358	.813
AN31-1-6	.136	1.24
Milgel	.0783	0
SV76-2-5	.920	6.63
P-1	.358	.603
P-2	.005	.008
P-3	1.09	6.49
P-4	.002	.011
P-5	.166	1.16
P-6	.043	0
P-7	.175	0
P-8	.161	2.42

*Concentrations expressed per unit volume of wet sample. Dissolved Bioassay Phase sample were not fractionated into aliphatic (F1), aromatic (F2) or polar (F3) fractions due to the chromotographic simplicity of the samples.

XIV D (cont). P-8 DRILLING FLUID - DISSOLVED BIOASSAY PHASE COMPONENTS

Compound Name	KOVAT No.	Concentration (µg/l)[a]
C_7-Alcohol	913	.4
C_8-Alcohol	1023	14.9
C_9-Ketone	1068	5.4
Methoxybenzaldehyde	1425	.9
C_{13}-Ketone	1499	3.0
Molecular Ion m/e = 170	1560	18.7
Methoxybenzoic Acid	1605	3.4
Hexadecanoic Acid	1990	2.6
Molecular Ion m/e = 199	1688	3.6
C_{18}-Carboxylic Acid	2165	1.3
C_{20}-Carboxylic Acid	2458	19.8

[a] Concentrations expressed per unit volume of wet sample.